VOLUME 26 / NUMBER 17
SEPTEMBER 8, 1988
ACC. NOS. N88-23715 TO N88-24572

STAR

AN ABSTRACT JOURNAL

PRODUCED BY THE
SCIENTIFIC AND TECHNICAL
INFORMATION
DIVISION

NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WHAT YOU CAN DO FOR *STAR*

All users of this abstract service are urged to forward reports to be considered for announcement in *STAR*. This will aid NASA in its efforts to provide the fullest possible coverage of all scientific and technical publications that might support aeronautics and space research and development. If you have prepared relevant reports (other than those that you will transmit to NASA, DoD, or DOE through the usual contract- or grant-reporting channels), please send them for consideration to the NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Maryland 21240.

Reprints of journal articles, book chapters, and conference papers are also welcome. These will be considered for announcement in *STAR*'s companion journal, *International Aerospace Abstracts*.

You may specify a particular source to be included in a report announcement if you wish; otherwise the report will be placed on public sale at the National Technical Information Service. Copyrighted publications will be announced but not distributed or sold.

PURCHASE OF *STAR*

The semimonthly issues are available for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

PUBLISHED BY:

UNITED STATES GOVERNMENT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SCIENTIFIC AND TECHNICAL INFORMATION DIVISION
Scientific and Technical Aerospace Reports, Volume 26, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by RMS Associates.

The Administrator of the National Aeronautics and Space Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through March 22, 1989.

US ISSN 0036-8741

INTRODUCTION

Scientific and Technical Aerospace Reports (STAR) is a major component of a comprehensive National Aeronautics and Space Administration information system covering aeronautics, space, and supporting disciplines. *STAR* is issued on the 8th and 23rd of each month and announces current publications of the following types:

- NASA, NASA contractor, and NASA grantee reports
- Reports issued by other U.S. Government Agencies, domestic and foreign institutions, universities, and private firms
- Translations in report form
- NASA-owned patents and patent applications
- Dissertations and theses

Journal, book, and conference literature, cover-to-cover journal translations, and certain foreign dissertations are announced in a companion journal, *International Aerospace Abstracts (IAA)*, available on subscription from the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, New York 10019.

SUBJECT SCOPE

Subject scope of *STAR*, and *IAA* includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

OTHER NASA PUBLICATIONS

Other NASA publications and information services are described in the publication, *The NASA Scientific and Technical Information System ... and How to Use It*, available without charge from the NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Maryland 21240.

HOW TO USE *STAR* SUBJECT CATEGORIES

STAR is categorized by 10 major subject divisions divided into 76 specific subject categories and one general category/division. The major subject divisions are listed in the Table of Contents, together with a note for each that defines its scope and provides any cross-references. For example:

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

Each major division is further divided into as many as nine specific categories, which are identified by category numbers.

Abstracts in *STAR* are grouped by specific category, the categories appearing in sequential order. Category breaks in the abstract section are identified by the category number and title, and a scope note. Cross-references to other categories are provided as appropriate. For example:

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

CROSS-REFERENCES

Individual *STAR* abstracts are not ordinarily cross-referenced, except for certain conference reports or book translations that have had separate abstracts written for their component papers or chapters. Citations and abstracts of the components follow immediately after those of the parent document. When the subject content of a component differs sufficiently from the general content of the parent, a cross-reference citation also is printed at the end of the category to which it normally would have been assigned if it were independent.

DOCUMENTS ON MICROFICHE

Documents on microfiche[1] are designated by a pound sign (#) following the accession number. The pound sign is used without regard to the source or quality of the microfiche.

AVAILABILITIES

One or more sources from which a document announced in *STAR* is available to the public is given in each citation. The most commonly indicated sources and their acronyms or abbreviations are listed below. If the publication is available from a source other than those listed, the publisher and his address will be displayed on the availability line or in combination with the corporate source line.

Avail: NTIS. Sold by the National Technical Information Service. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code following the letters HC or MF in the *STAR* citation. Current values for the price codes are given in the tables on page vii.

Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) is available at greatly reduced unit prices. For this service and for information concerning subscription to NASA printed reports, consult the NTIS Subscription Section, Springfield, Va. 22161.

NOTE ON ORDERING DOCUMENTS: When ordering NASA publications (those followed by the * symbol), use the N accession number. NASA patent applications (only the specifications are offered) should be ordered by the US-Patent-Appl-SN number. Non-NASA publications (no asterisk) should be ordered by the AD, PB, or other *report number* shown on the last line of the citation, not by the N accession number. It is also advisable to cite the title and other bibliographic identification.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The current price and order number are given following the availability line. (NTIS will fill microfiche requests, as indicated above, for those documents identified by a # symbol.)

(1) A microfiche is a transparent sheet of film, 105 by 148 mm in size, containing as many as 60 to 98 pages of information reduced to micro images (not to exceed 26:1 reduction).

Avail: BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, inquiry should be addressed to the BLL.)

Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in *Energy Research Abstracts*. Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center - Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.

Avail: ESDU. Pricing information on specific data, computer programs, and details on ESDU topic categories can be obtained from ESDU International Ltd. Requesters in North America should use the Virginia address while all other requesters should use the London address, both of which are on page vi.

Avail: Fachinformationszentrum, Karlsruhe. Sold by the Fachinformationszentrum Energie, Physik, Mathematik GMBH, Eggenstein Leopoldshafen, Federal Republic of Germany, at the price shown in deutschmarks (DM).

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, California. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.

Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration, Public Documents Room (Room 126), 600 Independence Ave., S.W., Washington, D.C. 20546, or public document rooms located at each of the NASA research centers, the NASA Space Technology Laboratories, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts* and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.

Avail: US Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of $1.50 each, postage free. (See discussion of NASA patents and patent applications below.)

Avail: (US Sales Only). These foreign documents are available to users within the United States from the National Technical Information Service (NTIS). They are available to users outside the United States through the International Nuclear Information Service (INIS) representative in their country, or by applying directly to the issuing organization.

Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed in this Introduction. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.

Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

NASA PATENTS AND PATENT APPLICATIONS

Patents and patent applications owned by NASA are announced in *STAR* under appropriate subject categories and are referenced in the *STAR* indexes. In the Report/Accession Number Index, patents are indexed by the NASA Case Number (which appears in lieu of the report number in other indexes), the U.S. Patent Number, the U.S. Patent Application Serial Number, and the U.S. Patent Class. Patent applications for which patents have not yet been issued are indexed by the NASA Case Number and the U.S. Patent Application Serial Number.

NASA *patent application specifications* are sold in paper copy by the National Technical Information Service at price code A02. Microfiche are sold at price code A01. The US-Patent-Appl-SN- number should be used in ordering either paper copy or microfiche from NTIS. Printed copies of *patents* (which are not microfiched) are available for purchase at $1.50 per copy from:

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, D.C. 20231

When ordering patents, the U.S. Patent Number should be used, and payment must be remitted in advance, preferably by money order or check payable to the Commissioner of Patents and Trademarks. Prepaid purchase coupons for ordering are also available from the Patent and Trademark Office. The patents and patent applications announced in *STAR* are owned by NASA and are available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

Associate General Counsel for Intellectual Property/Code GP
National Aeronautics and Space Administration
Washington, D.C. 20546

ELIGIBILITY AND REGISTRATION FOR NASA INFORMATION PRODUCTS AND SERVICES

A variety of services is available to organizations of the following types that have registered with NASA to receive specific services or products:

1. NASA offices, research centers, contractors, subcontractors, grantees, and consultants;
2. Other U.S. Government agencies and their contractors;
3. Libraries in the United States that have arrangements with NASA to maintain collections of NASA documents for public reference;
4. Other organizations in the United States having a need for NASA documents in work related to aeronautics and space research;
5. Organizations abroad that have established reciprocal document exchange arrangements with NASA.

Only the central service points or central points of document acquisition and control within qualified organizations are eligible to register for NASA products and services. Domestic organizations that may be eligible to receive various classes of NASA publications and services should address their requests for registration or for further information to:

NASA Scientific and Technical Information Facility
ATTN: Registration Activity
P.O. Box 8757
B.W.I. Airport, Maryland 21240

Organizations abroad should direct requests to the same address, but to the attention of: International Exchange Program.

AVAILABILITY OF *STAR* ABSTRACTS ON MICROFICHE

Microfiche of the abstract sections of this issue and other issues of *STAR* are available on annual subscription from NTIS as PB88-911300, Attn: Subscriptions, 5285 Port Royal Road, Springfield, Virginia 22161. Annual subscription rates are $70.00 North America; $140.00 foreign. Abstract sections for previous years retroactive to 1964 are available at the current rates. Microfiche for individual *STAR* issue abstract sections are not available.

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC: NASA and NASA-sponsored documents and a large number of aerospace publications are available to the public for reference purposes at the library maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, New York 10019

EUROPEAN: An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England for public access. The British Library Lending Division also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols # and * from ESA - Information Retrieval Service European Space Agency, 8-10 rue Mario-Nikis, 75738 Paris CEDEX 15, France.

FEDERAL DEPOSITORY LIBRARY PROGRAM

In order to provide the general public with greater access to U.S. Government publications, Congress established the Federal Depository Library Program under the Government Printing Office (GPO), with 50 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. At least one copy of nearly every NASA and NASA-sponsored publication, either in printed or microfiche format, is received and retained by the 50 regional depositories. A list of the regional GPO libraries, arranged alphabetically by state, appears on the inside back cover. These libraries are *not* sales outlets. A local library can contact a Regional Depository to help locate specific reports, or direct contact may be made by an individual.

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics
Technical Information Service
555 West 57th Street, 12th Floor
New York, New York 10019

British Library Lending Division,
Boston Spa, Wetherby, Yorkshire,
England

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, D.C. 20231

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

ESA-Information Retrieval Service
ESRIN
Via Galileo Galilei
00044 Frascati (Rome) Italy

ESDU International, Ltd.
1495 Chain Bridge Road
McLean, Virginia 22101

ESDU International, Ltd.
251-259 Regent Street
London, W1R 7AD, England

Fachinformationszentrum Energie, Physik, Mathematik GMBH
7514 Eggenstein Leopoldshafen
Federal Republic of Germany

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Scientific and Technical Information Facility
P.O. Box 8757
B.W.I. Airport, Maryland 21240

National Aeronautics and Space Administration
Scientific and Technical Information Division (NTT-1)
Washington, D.C. 20546

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Pendragon House, Inc.
899 Broadway Avenue
Redwood City, California 94063

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, Michigan 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Geological Survey Library
National Center - MS 950
12201 Sunrise Valley Drive
Reston, Virginia 22092

U.S. Geological Survey Library
2255 North Gemini Drive
Flagstaff, Arizona 86001

U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

U.S. Geological Survey Library
Box 25046
Denver Federal Center, MS914
Denver, Colorado 80225

NTIS PRICE SCHEDULES

(Effective January 1, 1988)

Schedule A
STANDARD PRICE DOCUMENTS AND MICROFICHE

PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE
A01	$ 6.95	$13.90
A02	9.95	19.90
A03	12.95	25.90
A04-A05	14.95	29.90
A06-A09	19.95	39.90
A10-A13	25.95	51.90
A14-A17	32.95	65.90
A18-A21	38.95	77.90
A22-A25	44.95	89.90
A99	*	*
NO1	49.50	89.90
NO2	48.00	80.00

Schedule E
EXCEPTION PRICE DOCUMENTS AND MICROFICHE

PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE
E01	$ 8.50	17.00
E02	11.00	22.00
E03	12.00	24.00
E04	14.50	29.00
E05	16.50	33.00
E06	19.00	38.00
E07	21.50	43.00
E08	24.00	48.00
E09	26.50	53.00
E10	29.00	58.00
E11	31.50	63.00
E12	34.00	68.00
E13	36.50	73.00
E14	39.50	79.00
E15	43.00	86.00
E16	47.00	94.00
E17	51.00	102.00
E18	55.00	110.00
E19	61.00	122.00
E20	71.00	142.00
E99	*	*

* Contact NTIS for price quote.

IMPORTANT NOTICE

NTIS Shipping and Handling Charges
U.S., Canada, Mexico — ADD $3.00 per TOTAL ORDER
All Other Countries — ADD $4.00 per TOTAL ORDER

Exceptions — Does NOT apply to:
ORDERS REQUESTING NTIS RUSH HANDLING
ORDERS FOR SUBSCRIPTION OR STANDING ORDER PRODUCTS *ONLY*

NOTE: Each additional delivery address on an order requires a separate shipping and handling charge.

VOLUME 26 NUMBER 17 / SEPTEMBER 8, 1988

TABLE OF CONTENTS

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics.*

01 AERONAUTICS (GENERAL) 2293

02 AERODYNAMICS 2295

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*

03 AIR TRANSPORTATION AND SAFETY 2300

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION N.A.

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE 2301

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

06 AIRCRAFT INSTRUMENTATION 2302

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

07 AIRCRAFT PROPULSION AND POWER 2307

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

08 AIRCRAFT STABILITY AND CONTROL 2308

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

09 RESEARCH AND SUPPORT FACILITIES (AIR) 2308

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*

12 ASTRONAUTICS (GENERAL) 2309

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

13 ASTRODYNAMICS N.A.

Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) 2309

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

15 LAUNCH VEHICLES AND SPACE VEHICLES 2310

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

16 SPACE TRANSPORTATION 2310

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING N.A.

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 2310

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

19 SPACECRAFT INSTRUMENTATION N.A.

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 SPACECRAFT PROPULSION AND POWER 2313

Includes main propulsion systems and components, e.g. rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

23 CHEMISTRY AND MATERIALS (GENERAL) 2315

24 COMPOSITE MATERIALS 2316

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

25 INORGANIC AND PHYSICAL CHEMISTRY 2317

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

26 METALLIC MATERIALS 2319

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 2322

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

28 PROPELLANTS AND FUELS N.A.

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

29 MATERIALS PROCESSING 2327

Includes space-based development of products and processes for commercial application.

For biological materials see *55 Space Biology.*

ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

For related information see also *Physics.*

31 ENGINEERING (GENERAL) 2331

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR 2332

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

33 ELECTRONICS AND ELECTRICAL ENGINEERING 2334

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

34 FLUID MECHANICS AND HEAT TRANSFER 2337

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 INSTRUMENTATION AND PHOTOGRAPHY 2341

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

36 LASERS AND MASERS 2344

Includes parametric amplifiers.

For related information see also *76 Solid-State Physics.*

37 MECHANICAL ENGINEERING 2344

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY 2346

Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS 2348

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

For related information see also *Space Sciences.*

42 GEOSCIENCES (GENERAL) 2350

43 EARTH RESOURCES AND REMOTE SENSING 2352

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

44 ENERGY PRODUCTION AND CONVERSION 2370

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION 2373

Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS 2373

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY 2375

Includes weather forecasting and modification.

48 OCEANOGRAPHY 2376

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

51 LIFE SCIENCES (GENERAL) 2377

52 AEROSPACE MEDICINE 2381

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES N.A.

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT 2382

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

55 SPACE BIOLOGY N.A.

Includes exobiology; planetary biology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) 2383

60 COMPUTER OPERATIONS AND HARDWARE 2384

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE 2384

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS 2390

Includes computer networks and special application computer systems.

63 CYBERNETICS 2390

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS 2391

Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY 2393

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS 2394

Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS 2394

Includes topology and number theory.

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

For related information see also *Engineering.*

70 PHYSICS (GENERAL) N.A.

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

71 ACOUSTICS 2394
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS 2396
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS 2398
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

74 OPTICS 2438
Includes light phenomena and optical devices.
For lasers see *36 Lasers and Masers.*

75 PLASMA PHYSICS 2439
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS 2445
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 2447
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 2448
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE N.A.
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 2449
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION N.A.
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 2449
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 2450
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 2451
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 2452
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 2453
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

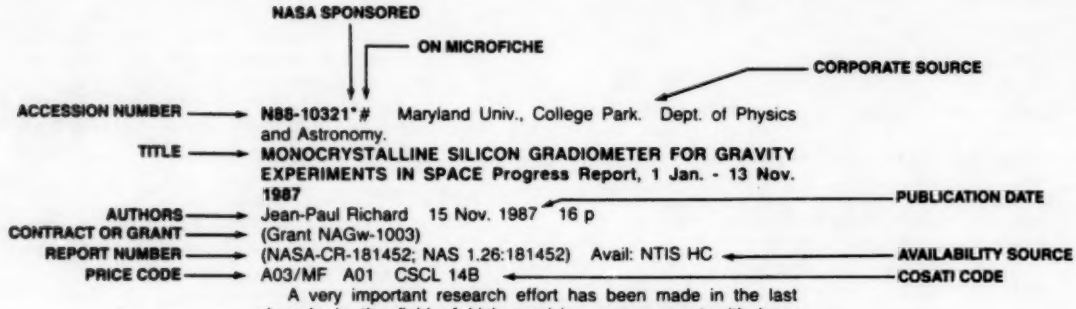
Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 2453

Note: N.A. means that no abstracts were assigned to this category for this issue.

SUBJECT INDEX I-1
PERSONAL AUTHOR INDEX I-47
CORPORATE SOURCE INDEX I-55
CONTRACT NUMBER INDEX I-65
REPORT/ACCESSION NUMBER INDEX I-67

TYPICAL CITATION AND ABSTRACT



A very important research effort has been made in the last decade in the field of high precision measurement with laser instrumentation. The development of a space borne gradiometer operating at a high sensitivity level using laser measurement of the distance between proof mass over a short base line of order one meter is discussed. Two aspects of laser technology make it a promising tool for gradiometry measurements: quantum limited accuracy and absolute distance measurements. The quantum limit associated with laser instrumentation was formulated. The relevant quantum and classical sources of errors in laser measurements were reviewed and corresponding laser performance requirements for gradient measurements were evaluated. Some mechanical quality factor measurements were made on simple resonant monocrystalline silicon suspensions. It was discovered that the use of zero derivative restoring forces to position the gradiometer test masses will dramatically reduce the gradiometer temperature control requirements. A laser beam side injection scheme was discovered which permits rejection of common mode accelerations. These concepts are briefly discussed. Author

VOLUME 26 NUMBER 17/ SEPTEMBER 8, 1988

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N88-23715*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
JOINT UNIVERSITY PROGRAM FOR AIR TRANSPORTATION RESEARCH, 1986
Frederick R. Morrell, comp. Apr. 1988 115 p Meeting held in Hampton, Va., 8-9 Jan. 1987; sponsored by NASA, Langley Research Cetner, Hampton, Va. and FAA, Washington, D.C. Sponsored by NASA, Washington
(NASA-CP-2502; L-16406; NAS 1.55:2502) Avail: NTIS HC A06/MF A01 CSCL 01B

The research conducted under the NASA/FAA sponsored Joint University Program for Air Transportation Research is summarized. The Joint University Program is a coordinated set of three grants sponsored by NASA and the FAA, one each with the Mass. Inst. of Tech., Ohio Univ., and Princeton Univ. Completed works, status reports, and bibliographies are presented for research topics, which include computer science, guidance and control theory and practice, aircraft performance, flight dynamics, and applied experimental psychology. An overview of activities is presented. For individual titles, see N88-23716 through N88-23727.

N88-23716*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY, 1986 **c03**
Robert W. Simpson *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 3-6 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01C

There were three areas of research sponsored in the Flight Transportation Lab. at MIT under the Joint University Research Program during 1986. The first was the completion of efforts investigating the possibility of using Loran-C for final approach guidance to a runway; the second is a preliminary exploration of the application of automated speech recognition in Air Traffic Control; the third is a continuation of a series of research topics into aircraft icing problems. Author

N88-23717*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IN-FLIGHT MEASUREMENT OF ICE GROWTH ON AN AIRFOIL USING AN ARRAY OF ULTRASONIC TRANSDUCERS **c03**
R. John Hansman, Jr., Mark S. Kirby, Robert C. McKnight, and Robert L. Humes (Calspan Corp., Arnold AFS, Tenn.) *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 7-15 Sponsored in cooperation with FAA (For primary document see N88-23715 17-01)
(Grants NGL-22-009-640; NAG3-666)
(AIAA-Paper-87-0178) Avail: NTIS HC A06/MF A01 CSCL 01C

Results of preliminary tests to measure ice growth on an airfoil during flight icing conditions are presented. Ultrasonic pulse echo measurements of ice thickness are obtained from an array of eight ultrasonic transducers mounted flush with the leading edge of the airfoil. These thickness measurements are used to document the evolution of the ice shape during the encounter in the form of successive ice profiles. Results from 3 research flights are presented and discussed. The accuracy of the ultrasonic measurements is found to be within 0.5 mm of mechanical and stereo photograph measurements of the ice accretion. Author

N88-23718*# Massachusetts Inst. of Tech., Cambridge.
EXPERIMENTAL MEASUREMENTS OF HEAT TRANSFER FROM AN ICED SURFACE DURING ARTIFICIAL AND NATURAL CLOUD ICING CONDITIONS **c34**
Mark S. Kirby and R. John Hansman, Jr. *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 17-26 Previously announced in IAA as A86-39948 Sponsored in cooperation with FAA (For primary document see N88-23715 17-01)
(Grants NGL-22-009-640; NAG3-666)
(AIAA-Paper-86-1352) Avail: NTIS HC A06/MF A01 CSCL 20D

The heat transfer behavior of accreting ice surfaces in natural (flight test) and simulated (wind tunnel) cloud icing conditions were studied. Observations of wet and dry ice growth regimes as measured by ultrasonic pulse echo techniques were made. Observed wet and dry ice growth regimes at the stagnation point of a cylinder were compared with those predicted using a quasi steady state heat balance model. A series of heat transfer coefficients were employed by the model to infer the local heat transfer behavior of the actual ice surfaces. The heat transfer in the stagnation region was generally inferred to be higher in wind tunnel icing tests than in natural flight icing conditions. Author

N88-23719*# Ohio Univ., Athens. Dept. of Electrical Engineering.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT OHIO UNIVERSITY, 1986 **c03**
Richard H. McFarland *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 29-31 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01C

Several important goals were achieved with the work supported by the Joint University Program. Among these goals is the first DC-3 flight with a Navstar Global Positioning System (GPS) receiver collecting positional data and allowing comparisons with simultaneous collected data from the Long Range Navigation system Loran C. The principle purpose for this instrumentation was to learn of the detailed characteristics evident in the Doppler frequency shift from signals being received onboard an aircraft in flight. Author

N88-23720*# Ohio Univ., Athens. Avionics Engineering Center.
LORAN-C MONITOR CORRELATION OVER A 92-MILE BASELINE IN OHIO **c04**
Robert W. Lilley and Jamie S. Edwards *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 33-40 (For primary document see N88-23715 17-01)
(Contract DTRS-57-83-C-00097)
Avail: NTIS HC A06/MF A01 CSCL 17G

Two Loran C monitors, at Galion and Athens, Ohio, were

operated over a one-year period, measuring chain 9960 Time Delay (TD) and Signal to Noise Ratio (SNR). Analysis of data concentrated on correlation of short term TD variations during the winter months of 1985 to 86, over the 92 nm baseline. Excellent correlation was found, with slight additional improvement possible if local temperature is also included in the analysis. Although SNR and TD effects were suspected during the presence of thunderstorms near the monitors, the scope of the study did not permit storm by storm analysis. A computer tape data base of all measurements was produced, with measurements at both sites included. Data recording and analysis concentrated on the fall and winter months of September 1985 to February 1986. Author

N88-23721*# Ohio Univ., Athens.
DATAC BUS MONITOR **c06**
Stanley M. Novacki, III and Robert J. Thomas, Jr. *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 41-43 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01D

The Digital Autonomous Terminal Access Communications (DATAC) bus is a multiple transmitter data bus developed to interconnect various aircraft systems. A typical DATAC bus installation for the NASA B-737 aircraft is shown. A bus monitor unit was developed for the DATAC data bus. The bus monitor unit consists of two systems: A Zilog Z8002 based S100 bus microcomputer system that connects to a DATAC terminal and receives data appearing on the bus, and an IMB PC-compatible computer used to display and interpret that data. Test results of the existing bus monitor have indicated areas for improvement. The most obvious improvement is to increase the speed of the data transfers between the S100 and the MS-DOS systems. Author

N88-23722*# Ohio Univ., Athens.
INTEGRATED MULTISENSOR NAVIGATION SYSTEMS **c04**
Frank vanGraas *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 45-50 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 17G

The multisensor navigation systems research evolved from the availability of several stand alone navigation systems and the growing concern for aircraft navigation reliability and safety. The intent is to develop a multisensor navigation system during the next decade that will be capable of providing reliable aircraft position data. These data will then be transmitted directly, or by satellite, to surveillance centers to aid the process of air traffic flow control. In order to satisfy the requirements for such a system, the following issues need to be examined: performance, coverage, reliability, availability, and integrity. The presence of a multisensor navigation system in all aircraft will improve safety for the aviation community and allow for more economical operation. Author

N88-23723*# Ohio Univ., Athens.
INTEGRATED AVIONICS RELIABILITY **c06**
Dimitri Alikiotis *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 51-59 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01D

The integrated avionics reliability task is an effort to build credible reliability and/or performability models for multisensor integrated navigation and flight control. The research was initiated by the reliability analysis of a multisensor navigation system consisting of the Global Positioning System (GPS), the Long Range Navigation system (Loran C), and an inertial measurement unit (IMU). Markov reliability models were developed based on system failure rates and mission time. Author

N88-23724*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT PRINCETON UNIVERSITY, 1986 **c03**
Robert F. Stengel *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 61-69 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01F

The Air Transportation Technology Program at Princeton proceeded along four avenues: Guidance and control strategies for penetration of microbursts and wind shear; Application of artificial intelligence in flight control systems; Computer aided control system design; and Effects of control saturation on closed loop stability and response of open loop unstable aircraft. Areas of investigation relate to guidance and control of commercial transports as well as general aviation aircraft. Interaction between the flight crew and automatic systems is a subject of prime concern. Author

N88-23725*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
RULE-BASED FAULT-TOLERANT FLIGHT CONTROL **c08**
Dave Handelman *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 71-79 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01C

Fault tolerance has always been a desirable characteristic of aircraft. The ability to withstand unexpected changes in aircraft configuration has a direct impact on the ability to complete a mission effectively and safely. The possible synergistic effects of combining techniques of modern control theory, statistical hypothesis testing, and artificial intelligence in the attempt to provide failure accommodation for aircraft are investigated. This effort has resulted in the definition of a theory for rule based control and a system for development of such a rule based controller. Although presented here in response to the goal of aircraft fault tolerance, the rule based control technique is applicable to a wide range of complex control problems. Author

N88-23726*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
IT'S TIME TO REINVENT THE GENERAL AVIATION AIRPLANE **c05**
Robert F. Stengel *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 81-105 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01C

Current designs for general aviation airplanes have become obsolete, and avenues for major redesign must be considered. New designs should incorporate recent advances in electronics, aerodynamics, structures, materials, and propulsion. Future airplanes should be optimized to operate satisfactorily in a positive air traffic control environment, to afford safety and comfort for point-to-point transportation, and to take advantage of automated manufacturing techniques and high production rates. These requirements have broad implications for airplane design and flying qualities, leading to a concept for the Modern Equipment General Aviation (MEGA) airplane. Synergistic improvements in design, production, and operation can provide a much needed fresh start for the general aviation industry and the traveling public. In this investigation a small four place airplane is taken as the reference, although the proposed philosophy applies across the entire spectrum of general aviation. Author

N88-23727*# Princeton Univ., N. J.
FLIGHT PENETRATION OF WIND SHEAR: CONTROL STRATEGIES **c03**
Amit S. Joshi *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 107-117 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01F

Wind shear is a dangerous condition where there is a sharp change in the direction and magnitude of the wind velocity over a short distance or time. This condition is especially dangerous to aircraft during landing and takeoff and can cause a sudden loss of lift and thereby height at a critical time. A numerical simulation showed the effective performance of the Linear Quadratic Regulator

and the Nonlinear Inverse Dynamics controllers. The major conclusions are listed and discussed. Author

N88-23728*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
METHODOLOGY FOR MATCHING EXPERIMENTAL AND COMPUTATIONAL AERODYNAMIC DATA
Carol D. Wieseman May 1988 13 p Presented at the AIAA/ASME/ASCE/AHS/ASC 29th Structures, Structural Dynamics, and Materials Conference in Williamsburg, Va., 18-20 Apr. 1988 Previously announced in IAA as A88-32324
(NASA-TM-100592; NAS 1.15:100592; AIAA-88-2392) Avail: NTIS HC A03/MF A01 CSCL 01B

Correction factor methodologies have been developed which use steady experimental or analytical pressure or force data to correct steady and unsteady aerodynamic calculations. Three methods of calculating correction factors have been developed to match steady surface pressure distributions, to match airfoil section forces and moments. Data for a rectangular supercritical wing that was previously tested in the NASA Langley Research Center Transonic Dynamics Tunnel have been used to determine correction factors to match surface pressure distributions for a range of Mach numbers. Author

N88-23729*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A NUMERICAL STUDY OF THE HOT GAS ENVIRONMENT AROUND A STOVL AIRCRAFT IN GROUND PROXIMITY
Thomas J. VanOverbeke and James D. Holdeman [1988] 28 p Prepared for presentation at the 24th Joint Propulsion Conference, Boston, Mass., 11-13 Jul. 1988; sponsored in part by AIAA, ASME, SAE, and ASEE
(NASA-TM-100895; E-4138; NAS 1.15:100895) Avail: NTIS HC A03/MF A01 CSCL 01B

The development of Short Takeoff Vertical Landing (STOVL) aircraft has historically been an empirical- and experience-based technology. In this study, a 3-D turbulent flow CFD code was used to calculate the hot gas environment around an STOVL aircraft operating in ground proximity. Preliminary calculations are reported for a typical STOVL aircraft configuration to identify key features of the flow field, and to demonstrate and assess the capability of current 3-D CFD codes to calculate the temperature of the gases ingested at the engine inlet as a function of flow and geometric conditions. Author

N88-23745*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MANUFACTURING REQUIREMENTS
Bruce J. Holmes, Clifford J. Obara, Glen L. Martin, and Christopher S. Domack (PRC Kentron, Inc., Hampton, Va.) *In its* Laminar Flow Aircraft Certification May 1986 p 171-183 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01B

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N88-23730# Institut de Mecanique des Fluides de Lille (France). Groupe Mecanique des Fluides Fondamentale.
STUDY OF A SYSTEM FOR REDUCING BASE DRAG BY CONTROLLING VORTICES [ETUDE D'UN DISPOSITIF REDUCTEUR DE TRAINEE DE CULOT PAR CONTROLE DES TOURBILLONS]
O. Rodriguez and J. Pruvost 20 Oct. 1987 52 p In FRENCH (Contract DRET-86-003/05)
(Rept-87/43; ETN-88-92301) Avail: NTIS HC A04/MF A01

The aerodynamics of a device which uses a slotted base to reduce drag was studied. Flow around the base was visualized in a water tunnel using streak photography and injected dyes. Results were compared with those of ultrahigh speed photography in two directions of compressible flow and with measurements of average and unsteady pressure. The comparisons show that the streak photography method reveals flow structures, although their origins and exact identification remain difficult. A significant drag reduction is achieved, but is unevenly distributed over the body and better design is needed to fully exploit the possibilities of the drag reduction device. ESA

N88-23731# Royal Aircraft Establishment, Farnborough (England).
AN ASSESSMENT OF THE DRAG REDUCTION PROPERTIES OF RIBLETS AND THE PENALTIES OF OFF-DESIGN CONDITIONS
L. Gaudet Aug. 1987 23 p
(RAE-TM-AERO-2113; BR104824; ETN-88-92510) Copyright Avail: NTIS HC A03/MF A01

The performance of riblets in reducing skin friction in turbulent flow was assessed. The data of Sawyer and Winter is used to develop skin-friction relationships derived from the velocity profile for a turbulent boundary layer as modified by a riblet surface. The maximum percentage drag reduction is shown to vary with Reynolds number, Rx. At large values of the nondimensional riblet height the riblet surface acts as a uniform roughness and a value for the equivalent sand-grain roughness height is given. The skin-friction relationships derived from the velocity profile as modified by the riblet surface show that for an optimum riblet size, reductions in skin friction of 7 percent may be achieved at Rx = 10 million, but at Rx = 1 billion the reduction is 5 percent. Applied to the BAe 125 and the A300, for example, the analysis implies maximum possible reductions in the drag coefficient of 0.00065 and 0.00047 respectively. These savings decrease if it is not feasible to apply the riblets in regions which are surface-flow sensitive. ESA

N88-23732*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SATURATION AND THE LIMIT OF JET MIXING ENHANCEMENT BY SINGLE FREQUENCY PLANE WAVE EXCITATION: EXPERIMENT AND THEORY
Ganesh Raman, Edward J. Rice, and Reda R. Mankbadi (Brown Univ., Providence, R. I.) [1988] 16 p Prepared for presentation at the 1st National Fluid Dynamics Congress, Cincinnati, Ohio, 24-28 Jul. 1988; sponsored in part by AIAA, ASME, ASCE, SIAM, and APS
(NASA-TM-100882; E-4115; NAS 1.15:100882) Avail: NTIS HC A03/MF A01 CSCL 01A

The limitations of single frequency plane wave excitation in mixing enhancement are investigated for a circular jet. Measurements made in an 8.8 cm diameter jet are compared with a theoretical model. The measurements are made to quantify mixing at excitation amplitudes up to 2 percent of the jet exit velocity. The initial boundary layer state, the exit mean and fluctuating velocity profiles and spectra are documented for all cases considered. The amplitude of the fundamental wave is recorded along the jet axis for various levels of excitation. As the amplitude of excitation is increased the jet spreading rate is increased, but beyond a saturation amplitude further increases have no effect on the spreading. The experimental results are compared with theoretical estimates. In the theory the flow is split into the mean flow, large scale motions, and fine scale turbulence. Shape assumptions for the mean flow, and fine scale turbulence along with the shape for the large scale motions obtained from a linear stability theory provide the closure. The experimental results compare reasonably well with predictions. Author

N88-23733 New South Wales Univ., Sydney (Australia). School of Mechanical and Industrial Engineering.
PROPULSIVE PERFORMANCE OF A LIFTING FLAPPING WING Ph.D. Thesis Abstract Only
Jeremy Blackwell Dec. 1986 418 p
Avail: Issuing Activity

A mathematical model of a lifting, flapping wing was created. Both a 3-dimensional wavy wake and a 2-dimensional flat wake approximation were examined. The flat wake solution was adequate only for small flapping amplitudes. Results show that horizontal flapping flight, requiring lift as well as thrust, whether for maximum thrust or propulsive efficiency, is likely to occur at low advance ratio. In addition, it is necessary that the wing be allowed to twist. Increased net lift results in a reduction of net thrust and propulsive efficiency. However, if the steady state component of drag (induced and profile) is debited to the body drag (the equivalent propeller condition), high thrusts and propulsive efficiencies are possible for a flapping wing, whether lifting or not. The effect of varying the wing chord during the flapping cycle and the fraction of cycle time spent on the downstroke were examined. It was found that for micro not equal to 0.5 and sigma less than one (where micro is the fraction of cycle time spent on the downstroke and sigma is the upstroke:downstroke wing chord ratio), thrust and propulsive efficiency could be significatly raised above the symmetric case micro equals 0.5 and sigma equals one. Author

N88-23734*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HIGH REYNOLDS NUMBER TESTS OF A DOUGLAS DLBA 032 AIRFOIL IN THE LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL
Charles B. Johnson, David A. Dress, Acquilla S. Hill, Peter A. Wilcox, and Minh H. Bui (Douglas Aircraft Co., Inc., Long Beach, Calif.) May 1986 126 p
(NASA-TM-87663; L-16083; NAS 1.15:87663) Avail: NTIS HC A07/MF A01 CSCL 01A

A wind-tunnel investigation of a Douglas advanced-technology airfoil was conducted in the Langley 0.3-Meter Transonic Cryogenic Tunnel (0.3-m TCT). The temperature was varied from 227 K (409 R) to 100 K (180 R) at pressures ranging from about 159 kPa (1.57 atm) to about 514 kPa (5.07 atm). Mach number was varied from 0.50 to 0.78. These variables provided a Reynolds number range (based on airfoil chord) from 6.0 to 30.0 x 10 to the 6th power. This investigation was specifically designed to: (1) test a Douglas airfoil from moderately low to flight-equivalent Reynolds numbers, and (2) evaluate sidewall-boundary-layer effects on transonic airfoil performance characteristics by a systematic variation of Mach number, Reynolds number, and sidewall-boundary-layer removal. Data are included which demonstrate the effects of fixing transition, Mach number, Reynolds number, and sidewall-boundary-layer removal on the aerodynamic characteristics of the airfoil. Also included are remarks on model design and model structural integrity. Author

N88-23735*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NUMERICAL SIMULATION OF SCRAMJET INLET FLOW FIELDS
Ajay Kumar May 1986 29 p
(NASA-TP-2517; L-16000; NAS 1.60:2517) Avail: NTIS HC A03/MF A01 CSCL 01A

A computer program was developed to analyze supersonic combustion ramjet (scramjet) inlet flow fields. The program solves the three-dimensional Euler or Reynolds averaged Navier-Stokes equations in full conservation form by either the fully explicit or explicit-implicit, predictor-corrector method of MacCormack. Turbulence is modeled by an algebraic eddy-viscosity model. The analysis allows inclusion of end effects which can significantly affect the inlet flow field. Detailed laminar and turbulent flow results are presented for a symmetric-wedge corner, and comparisons are made with the available experimental results to allow assessment of the program. Results are then presented for two inlet configurations for which experimental results exist at the NASA Langley Research Center. Author

N88-23736*# Rockwell International Corp., Los Angeles, Calif.
FULL POTENTIAL METHODS FOR ANALYSIS/DESIGN OF COMPLEX AEROSPACE CONFIGURATIONS
Vijaya Shankar, Kuo-Yen Szema, and Ellwood Bonner Washington NASA May 1986 157 p
(Contract NAS1-15820)
(NASA-CR-3982; NAS 1.26:3982) Avail: NTIS HC A08/MF A01 CSCL 01A

The steady form of the full potential equation, in conservative form, is employed to analyze and design a wide variety of complex aerodynamic shapes. The nonlinear method is based on the theory of characteristic signal propagation coupled with novel flux biasing concepts and body-fitted mapping procedures. The resulting codes are vectorized for the CRAY XMP and the VPS-32 supercomputers. Use of the full potential nonlinear theory is demonstrated for a single-point supersonic wing design and a multipoint design for transonic maneuver/supersonic cruise/maneuver conditions. Achievement of high aerodynamic efficiency through numerical design is verified by wind tunnel tests. Other studies reported include analyses of a canard/wing/nacelle fighter geometry. Author

N88-23737*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LAMINAR FLOW AIRCRAFT CERTIFICATION
Louis J. Williams, comp. May 1986 325 p Workshop held in Wichita, Kans., 15-16 Apr. 1985; sponsored by NASA, AIAA, SAE and FAA Sponsored by NASA, Washington
(NASA-CP-2413; L-16111; NAS 1.55:2413) Avail: NTIS HC A14/MF A01 CSCL 01A

Various topics relative to laminar flow aircraft certification are discussed. Boundary layer stability, flaps for laminar flow airfoils, computational wing design studies, manufacturing requirements, wind tunnel tests, and flow visualization are among the topics covered. For individual titles, see N88-23738 through N88-23749.

N88-23738*# Engineering and Science Consultants, Grafton, Va.
BOUNDARY-LAYER STABILITY AND AIRFOIL DESIGN
Jeffrey K. Viken *In* NASA, Langley Research Center, Laminar Flow Aircraft Certification May 1986 p 1-30 (For primary document see N88-23737 17-02)
(Contract NAS1-17670)
Avail: NTIS HC A14/MF A01 CSCL 01A

Several different natural laminar flow (NLF) airfoils have been analyzed for stability of the laminar boundary layer using linear stability codes. The NLF airfoils analyzed come from three different design conditions: incompressible; compressible with no sweep; and compressible with sweep. Some of the design problems are discussed, concentrating on those problems associated with keeping the boundary layer laminar. Also, there is a discussion on how a linear stability analysis was effectively used to improve the design for some of the airfoils. Author

N88-23739*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HIGH-FLAPS FOR NATURAL LAMINAR FLOW AIRFOILS
Harry L. Morgan *In its* Laminar Flow Aircraft Certification May 1986 p 31-6 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01A

A review of the NACA and NASA low-drag airfoil research is presented with particular emphasis given to the development of mechanical high-lift flap systems and their application to general aviation aircraft. These flap systems include split, plain, single-slotted, and double-slotted trailing-edge flaps plus slat and Krueger leading-edge devices. The recently developed continuous variable-camber high-lift mechanism is also described. The state-of-the-art of theoretical methods for the design and analysis of multi-component airfoils in two-dimensional subsonic flow is discussed, and a detailed description of the Langley MCARF (Multi-Component Airfoil Analysis Program) computer code is presented. The results of a recent effort to design a single- and

double-slotted flap system for the NASA high speed natural laminar flow (HSNLF) (1)-0213 airfoil using the MCARF code are presented to demonstrate the capabilities and limitations of the code.
Author

N88-23740*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPUTATIONAL WING DESIGN STUDIES RELATING TO NATURAL LAMINAR FLOW
Edgar G. Waggoner *In its* Laminar Flow Aircraft Certification May 1986 p 67-8 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01A

Two research studies are described which directly relate to the application of natural laminar flow (NLF) technology to transonic transport-type wing planforms. Each involved using state-of-the-art computational methods to design three-dimensional wing contours which generate significant runs of favorable pressure gradients. The first study supported the Variable Sweep Transition Flight Experiment and involves design of a full-span glove which extends from the leading edge to the spoiler hinge line on the upper surface of an F-14 outer wing panel. A wing was designed computationally for a corporate transport aircraft in the second study. The resulting wing design generated favorable pressure gradients from the leading edge aft to the mid-chord on both upper and lower surfaces at the cruise design point. Detailed descriptions of the computational design approach are presented along with the various constraints imposed on each of the designs.
Author

N88-23741*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND TUNNEL TESTING OF LOW-DRAG AIRFOILS
W. Donald Harvey, R. J. McGhee, and C. D. Harris *In its* Laminar Flow Aircraft Certification May 1986 p 89-128 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01A

Results are presented for the measured performance recently obtained on several airfoil concepts designed to achieve low drag by maintaining extensive regions of laminar flow without compromising high-lift performance. The wind tunnel results extend from subsonic to transonic speeds and include boundary-layer control through shaping and suction. The research was conducted in the NASA Langley 8-Ft Transonic Pressure Tunnel (TPT) and Low Turbulence Pressure Tunnel (LTPT) which have been developed for testing such low-drag airfoils. Emphasis is placed on identifying some of the major factors influencing the anticipated performance of low-drag airfoils.
Author

N88-23742*# PRC Kentron, Inc., Hampton, Va. Aerospace Technologies Div.
BOUNDARY LAYER FLOW VISUALIZATION FOR FLIGHT TESTING **c34**
Clifford J. Obara *In* NASA, Langley Research Center, Laminar Flow Aircraft Certification May 1986 p 129-140 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 20D

Flow visualization is used extensively in flight testing to determine aerodynamic characteristics such as surface flow direction and boundary layer state. Several visualization techniques are available to the aerodynamicist. Two of the most popular are oil flows and sublimating chemicals. Oil is used to visualize boundary layer transition, shock wave location, regions of separated flow, and surface flow direction. Boundary layer transition can also be visualized with sublimating chemicals. A summary of these two techniques is discussed, and the use of sublimating chemicals is examined in some detail. The different modes of boundary layer transition are characterized by different patterns in the sublimating chemical coating. The discussion includes interpretation of these chemical patterns and the temperature and velocity operating limitations of the chemical substances. Information for selection of appropriate chemicals for a desired set of flight conditions is provided.
Author

N88-23743*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BOUNDARY LAYER MEASUREMENTS USING HOT-FILM SENSORS **c34**
Harlan K. Holmes and Debra L. Carraway (Old Dominion Univ., Norfolk, Va.) *In its* Laminar Flow Aircraft Certification May 1986 p 141-153 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 20D

Measurements in the aerodynamic boundary layer using heat transfer, hot-film sensors are receiving a significant amount of effort at the Langley Research Center. A description of the basic sensor, the signal conditioning employed, and several manifestations of the sensor are given. Results of a flow reversal sensor development are presented, and future work areas are outlined.
Author

N88-23744*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLIGHT EXPERIENCES WITH LAMINAR FLOW **c05**
Bruce J. Holmes *In its* Laminar Flow Aircraft Certification May 1986 p 155-169 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01C

A review of natural laminar flow (NLF) flight experiences over the period from the 1930's to the present has been given to provide information on the achievability and maintainability of NLF in typical airplane operating environments. Significant effects of loss of laminar flow on airplane performance have been observed for several airplanes, indicating the importance of providing information on these changes to laminar flow airplane operators. Significant changes in airplane stability and control and maximum lift were observed in flight experiments with the loss of laminar flow. However, these effects can be avoided by proper selection of airfoils. Conservative laminar flow airfoil designs should be employed which do not experience significant loss of lift (caused by flow separation) upon the loss of laminar flow. Mechanisms have been observed for the effects of insect accumulation, flight through clouds and precipitation, and propeller slipstreams on laminar flow behavior. Fixed transition testing, in addition to free transition testing, is recommended as a new standard procedure for airplanes with surfaces designed to support laminar flow.
Author

N88-23745*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MANUFACTURING REQUIREMENTS **c01**
Bruce J. Holmes, Clifford J. Obara, Glen L. Martin, and Christopher S. Domack (PRC Kentron, Inc., Hampton, Va.) *In its* Laminar Flow Aircraft Certification May 1986 p 171-183 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01B

In recent years, natural laminar flow (NLF) has been proven to be achievable on modern smooth airframe surfaces over a range of cruise flight conditions representative of most current business and commuter aircraft. Published waviness and boundary layer transition measurements on several modern metal and composite airframes have demonstrated the fact that achievable surface waviness is readily compatible with laminar flow requirements. Currently, the principal challenge to the manufacture of NLF-compatible surfaces is two-dimensional roughness in the form of steps and gaps at structural joints. Results of recent NASA investigations on manufacturing tolerances for NLF surfaces, including results of a flight experiment are given. Based on recent research, recommendations are given for conservative manufacturing tolerances for waviness and shaped steps.
Author

N88-23746*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRELIMINARY AERODYNAMIC DESIGN CONSIDERATIONS FOR ADVANCED LAMINAR FLOW AIRCRAFT CONFIGURATIONS **c05**

Joseph L. Johnson, Jr., Long P. Yip, and Frank L. Jordan, Jr. *In its* Laminar Flow Aircraft Certification May 1986 p 185-225 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01C

Modern composite manufacturing methods have provided the opportunity for smooth surfaces that can sustain large regions of natural laminar flow (NLF) boundary layer behavior and have stimulated interest in developing advanced NLF airfoils and improved aircraft designs. Some of the preliminary results obtained in exploratory research investigations on advanced aircraft configurations at the NASA Langley Research Center are discussed. Results of the initial studies have shown that the aerodynamic effects of configuration variables such as canard/wing arrangements, airfoils, and pusher-type and tractor-type propeller installations can be particularly significant at high angles of attack. Flow field interactions between aircraft components were shown to produce undesirable aerodynamic effects on a wing behind a heavily loaded canard, and the use of properly designed wing leading-edge modifications, such as a leading-edge droop, offset the undesirable aerodynamic effects by delaying wing stall and providing increased stall/spin resistance with minimum degradation of laminar flow behavior. Author

N88-23747*# Vigyan Research Associates, Inc., Hampton, Va.
NATURAL LAMINAR FLOW AND AIRPLANE STABILITY AND CONTROL **c08**
Cornelis P. vanDam *In* NASA, Langley Research Center, Laminar Flow Aircraft Certification May 1986 p 227-245 (For primary document see N88-23737 17-02)
(Contract NAS1-17797)
Avail: NTIS HC A14/MF A01 CSCL 01C

Location and mode of transition from laminar to turbulent boundary layer flow have a dominant effect on the aerodynamic characteristics of an airfoil section. The influences of these parameters on the sectional lift and drag characteristics of three airfoils are examined. Both analytical and experimental results demonstrate that when the boundary layer transitions near the leading edge as a result of surface roughness, extensive trailing-edge separation of the turbulent boundary layer may occur. If the airfoil has a relatively sharp leading-edge, leading-edge stall due to laminar separation can occur after the leading-edge suction peak is formed. These two-dimensional results are used to examine the effects of boundary layer transition behavior on airplane longitudinal and lateral-directional stability and control. Author

N88-23748*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPERATIONAL CONSIDERATIONS FOR LAMINAR FLOW AIRCRAFT **c05**
Dal V. Maddalon and Richard D. Wagner *In its* Laminar Flow Aircraft Certification May 1986 p 247-268 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01C

Considerable progress has been made in the development of laminar flow technology for commercial transports during the NASA Aircraft Energy Efficiency (ACEE) laminar flow program. Practical, operational laminar flow control (LFC) systems have been designed, fabricated, and are undergoing flight testing. New materials, fabrication methods, analysis techniques, and design concepts were developed and show much promise. The laminar flow control systems now being flight tested on the NASA Jetstar aircraft are complemented by natural laminar flow flight tests to be accomplished with the F-14 variable-sweep transition flight experiment. An overview of some operational aspects of this exciting program is given. Author

N88-23749*# Federal Aviation Administration, Kansas City, Mo. Small Airplane Certification Directorate.
CERTIFICATION ASPECTS OF AIRPLANES WHICH MAY OPERATE WITH SIGNIFICANT NATURAL LAMINAR FLOW **c05**
Edward A. Gabriel and Earsa L. Tankesley *In* NASA, Langley Research Center, Laminar Flow Aircraft Certification May 1986 p 269-277 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01C

Recent research by NASA indicates that extensive natural laminar flow (NLF) is attainable on modern high performance airplanes currently under development. Modern airframe construction methods and materials, such as milled aluminum skins, bonded aluminum skins, and composite materials, offer the potential for production of aerodynamic surfaces having waviness and roughness below the values which are critical for boundary layer transition. Areas of concern with the certification aspects of Natural Laminar Flow (NLF) are identified to stimulate thought and discussion of the possible problems. During its development, consideration has been given to the recent research information available on several small business and experimental airplanes and the certification and operating rules for general aviation airplanes. The certification considerations discussed are generally applicable to both large and small airplanes. However, from the information available at this time, researchers expect more extensive NLF on small airplanes because of their lower operating Reynolds numbers and cleaner leading edges (due to lack of leading-edge high lift devices). Further, the use of composite materials for aerodynamic surfaces, which will permit incorporation of NLF technology, is currently beginning to appear in small airplanes. Author

N88-23750*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PAN AIR ANALYSIS OF THE NASA/MCAIR 279-3: AN ADVANCED SUPERSONIC V/STOL FIGHTER/ATTACK AIRCRAFT
Michael D. Madson and Larry L. Erickson Apr. 1986 40 p
(NASA-TM-86838; A-85414; NAS 1.15:86838) Avail: NTIS HC A03/MF A01 CSCL 01A

PAN AIR is a computer program for predicting subsonic or supersonic linear potential flow about arbitrary configurations. The program was applied to a highly complex single-engine-cruise V/STOL fighter/attack aircraft. Complexities include a close-coupled canard/wing, large inlets, and four exhaust nozzles mounted directly under the wing and against the fuselage. Modeling uncertainties involving canard wake location and flow-through approximation through the inlet and the exhaust nozzles were investigated. The recently added streamline capability of the program was utilized to evaluate visually the predicted flow over the model. PAN AIR results for Mach numbers of 0.6, 0.9, and angles of attack of 0, 5, and 10 deg. were compared with data obtained in the Ames 11- by 11-Foot Transonic Wind tunnel, at a Reynolds number of 3.69 x 10 to the 6th power based on c bar. Author

N88-23751*# Lockheed Aeronautical Systems Co., Marietta, Ga.
ACOUSTICALLY EXCITED HEATED JETS. 1: INTERNAL EXCITATION Final Contractor Report
J. Lepicovsky, K. K. Ahuja, W. H. Brown, M. Salikuddin, and P. J. Morris (Pennsylvania State Univ., University Park.) Washington NASA Jun. 1988 135 p
(Contract NAS3-23708)
(NASA-CR-4129-Pt-1; E-4001; NAS 1.26:4129-Pt-1; LG86ER0022-Pt-1) Avail: NTIS HC A07/MF A01 CSCL 01A

The effects of relatively strong upstream acoustic excitation on the mixing of heated jets with the surrounding air are investigated. To determine the extent of the available information on experiments and theories dealing with acoustically excited heated jets, an extensive literature survey was carried out. The experimental program consisted of flow visualization and flowfield velocity and temperature measurements for a broad range of jet operating and flow excitation conditions. A 50.8-mm-diam nozzle was used for this purpose. Parallel to the experimental study, an existing theoretical model of excited jets was refined to include the region downstream of the jet potential core. Excellent agreement was found between theory and experiment in moderately heated jets. However, the theory has not yet been confirmed for

highly heated jets. It was found that the sensitivity of heated jets to upstream acoustic excitation varies strongly with the jet operating conditions and that the threshold excitation level increases with increasing jet temperature. Furthermore, the preferential Strouhal number is found not to change significantly with a change of the jet operating conditions. Finally, the effects of the nozzle exit boundary layer thickness appear to be similar for both heated and unheated jets at low Mach numbers. Author

N88-23752*# Lockheed Aeronautical Systems Co., Marietta, Ga.

ACOUSTICALLY EXCITED HEATED JETS. 2: IN SEARCH OF A BETTER UNDERSTANDING Final Contractor Report

J. Lepicovsky, K. K. Ahuja, W. H. Brown, M. Salikuddin, and P. J. Morris (Pennsylvania State Univ., University Park.) Washington NASA Jun. 1988 90 p

(Contract NAS3-23708)

(NASA-CR-4129-Pt-2; E-4002; NAS 1.26:4129-Pt-2; LG86ER0022-Pt-2) Avail: NTIS HC A05/MF A01 CSCL 01A

The second part of a three-part report on the effects of acoustic excitation on jet mixing includes the results of an experimental investigation directed at resolving the question of poor excitability of some of the heated jets. The theoretical predictions discussed in Part 1 are examined to find explanations for the observed discrepancies between the measured and the predicted results. Additional testing was performed by studying the self excitation of the shock containing hot jets and also by exciting the jet by sound radiated through source tubes located externally around the periphery of the jet. The effects of nozzle-exit boundary layer conditions on jet excitability was also investigated. It is concluded that high-speed, heated jet mixing rates and consequently also the jet excitability strongly depends on nozzle exit boundary layer conditions. Author

N88-23753*# Lockheed Aeronautical Systems Co., Marietta, Ga.

ACOUSTICALLY EXCITED HEATED JETS. 3: MEAN FLOW DATA Final Contractor Report

J. Lepicovsky, K. K. Ahuja, W. H. Brown, M. Salikuddin, and P. J. Morris (Pennsylvania State Univ., University Park.) Washington NASA Jun. 1988 116 p

(Contract NAS3-23708)

(NASA-CR-4129-Pt-3; E-4003; NAS 1.26:4129-Pt-3; LG86ER0022-Pt-3) Avail: NTIS HC A06/MF A01 CSCL 01A

This is Part 3 of a report on the excitability of heated jets under the influence of acoustic excitation. The effects of upstream internal acoustic excitation on jet mixing were described in Part 1. Part 2 described the effects of external excitation on flow mixing. Part 3 contains quantitative results from the measurements of mean Mach number and temperature and consists of radial profiles and centerline distributions measured at selected jet operating conditions for internally excited and unexcited jets. The mean flow data are presented in both graphical and tabulated forms. For the sake of completeness, this part contains temperature probe calibration curves also. Author

N88-23754# George Washington Univ., Washington, D.C. Graduate School of Engineering and Applied Science.

WIND-TUNNEL INVESTIGATION OF ACTUATED FOREBODY STRAKES FOR YAW CONTROL AT HIGH ANGLES OF ATTACK

Daniel G. Murri May 1987 95 p

Avail: NTIS HC A05/MF A01

Wind-tunnel studies are conducted to evaluate the potential of actuated forebody strakes to provide increased levels of yaw control on fighter aircraft at stall and post-stall angles of attack where conventional aerodynamic controls are ineffective. The studies involved low-speed wind-tunnel tests of actuated forebody strake concepts applied to a generic fighter model and included circumferential pressure and flow visualization surveys on an isolated forebody. Results showed that the actuated forebody strake concept can provide high levels of yaw control over wide angle-of-attack and sideslip ranges. However, significant interaction effects that reduced the yaw control effectiveness of the strakes or induced coupled rolling and pitching moments occurred when lifting surfaces were placed in close proximity to the forebody/strake combination. Two fundamentally different flow mechanisms were identified that were responsible for the yawing moments generated by the strakes. Author

N88-23755*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

INFLOW MEASUREMENT MADE WITH A LASER VELOCIMETER ON A HELICOPTER MODEL IN FORWARD FLIGHT. VOLUME 5: TAPERED PLANFORM BLADES AT AN ADVANCE RATIO OF 0.23

Susan L. Althoff, Joe W. Elliott, and Richard H. Sailey (PRC Kentron, Inc., Hampton, Va.) Apr. 1988 355 p

(NASA-TM-100545; NAS 1.15:100545; AVSCOM-TM-88-B-008-Vol-5) Avail: NTIS HC A16/MF A01 CSCL 01A

An experimental investigation was conducted in the 14- by 22-Foot Subsonic tunnel at NASA Langley Research Center to measure the inflow into a scale model helicopter rotor in forward flight (mu sub inf = 0.23). The measurements were made with a two component Laser Velocimeter (LV) one chord above the plane formed by the path of the blade tips. A conditional sampling technique was employed to determine the position of the rotor at the time that each velocity measurement was made so that the azimuthal fluctuations in velocity could be determined. Measurements were made at a total of 168 separate locations in order to clearly define the inflow character. This data is presented without analysis. In order to increase the availability of the resulting data, both the mean and azimuthally dependenet values are included as part of this report on two 5.25 inch floppy disks in Microsoft Corporation MS-DOS format. Author

N88-23756*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

UNSTEADY PRESSURE AND STRUCTURAL RESPONSE MEASUREMENTS OF AN ELASTIC SUPERCRITICAL WING

Clinton V. Eckstrom, David A. Seidel, and Maynard C. Sandford May 1988 13 p Presented at the AIAA/ASME/ASCE/AHS/ASC 29th Structures, Structural Dynamics, and Materials Conference, Williamsburg, Va., 18-20 Apr. 1988 Previously announced in IAA as A88-32231

(NASA-TM-100591; NAS 1.15:100591; AIAA-Paper-88-2277) Avail: NTIS HC A03/MF A01 CSCL 01A

Results are presented which define unsteady flow conditions associated with high dynamic response experienced on a high aspect ratio elastic supercritical wing at transonic test conditions while being tested in the NASA Langley Transonic Dynamics Tunnel. The supercritical wing, designed for a cruise Mach number of 0.80, experienced the high dynamic response in the Mach number range from 0.90 to 0.94 with the maximum response occurring at a Mach number of approximately 0.92. At the maximum wing response condition the forcing function appears to be the oscillatory chordwise movement of strong shocks located on both the wing upper and lower surfaces in conjunction with the flow separating and reattaching in the trailing edge region. Author

N88-23757*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AEROPROPULSIVE CHARACTERISTICS OF ISOLATED COMBINED TURBOJET/RAMJET NOZZLES AT MACH NUMBERS FROM 0 TO 1.20

George T. Carson, Jr. and Milton Lamb Jun. 1988 174 p

(NASA-TP-2814; L-16390; NAS 1.60:2814) Avail: NTIS HC A08/MF A01 CSCL 01A

An investigation was conducted in the Langley 16-Foot Transonic Tunnel to determine the aeropropulsive performance characteristics (the aerodynamic quantities affected by propulsion) of 13 isolated combined turbojet/ramjet nozzle configurations. These configurations simulated the variable-geometry features of two nozzle designs designated as the multiple-expansion ramp nozzle (MERN) and the composite contour nozzle (CCN). Test

data were obtained at static conditions and at Mach numbers of 0.60, 0.90, and 1.20 with jet exhaust simulated by high-pressure air. The results showed that the CCN had the higher performance over the Mach number range than the MERN, as indicated by the difference of thrust minus drag divided by ideal thrust. Increasing the ramjet throat area for the MERN resulted in an increase in performance that increased with Mach number. For the CCN at Mach numbers less than 1.20, increasing the ramjet throat area resulted in a loss in performance. Author

N88-23758*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRESSURE DISTRIBUTIONS FROM SUBSONIC TESTS OF AN ADVANCED LAMINAR-FLOW-CONTROL WING WITH LEADING- AND TRAILING-EDGE FLAPS
Zachary T. Applin and Garl L. Gentry, Jr. Jul. 1988 32 p
(NASA-TM-4040-Pt-1; L-16405; NAS 1.15:4040-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 01A

An unswept, semispan wing model equipped with full-span leading- and trailing-edge flaps was tested in the Langley 14- by 22-Foot Subsonic Tunnel to determine the effect of high-lift components on the aerodynamics of an advanced laminar-flow-control (LFC) airfoil section. Chordwise pressure distributions near the midsemispan were measured for four configurations: cruise, trailing-edge flap only, and trailing-edge flap with a leading edge Kreuger flap of either 0.10 or 0.12 chord. Part 1 of this report presents a representative sample of the plotted pressure distribution data for each configuration tested. Part 2 (under separate cover) presents the entire set of plotted and tabulated pressure distribution data. The data are presented without analysis. Author

N88-23759* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CROSSFLOW VORTICITY SENSOR Patent
Bruce J. Holmes, inventor (to NASA), Debra L. Carraway, inventor (to NASA) (Old Dominion Univ., Hampton, Va.), Harlan K. Holmes, inventor (to NASA), and Thomas C. Moore, inventor (to NASA) 1 Mar. 1988 9 p Filed 15 Jan. 1987 Supersedes N87-23587 (25 - 19, p 2616)
(NASA-Case-LAR-13436-1-CU; US-Patent-4,727,751; US-Patent-Appl-SN-003676; US-Patent-Class-73-147; US-Patent-Class-73-178-R) Avail: US Patent and Trademark Office CSCL 01A

A crossflow vorticity sensor for the detection of crossflow vorticity characteristics is described. The sensor is comprised of crossflow sensors which are noninvasively adhered to a swept wing laminar surface either singularly, in multi-element strips, in polar patterns, or in orthogonal patterns. These crossflow sensors are comprised of hot-film sensor elements which operate as a constant temperature anemometer circuit to detect heat transfer rate changes. Accordingly, crossflow vorticity characteristics are determined via cross-correlation. In addition, the crossflow sensors have a thickness which does not exceed a maximum value h in order to avoid contamination of downstream crossflow sensors.
Official Gazette of the U.S. Patent and Trademark Office

N88-23760*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SENSITIVITY OF F-106B LEADING-EDGE-VORTEX IMAGES TO FLIGHT AND VAPOR-SCREEN PARAMETERS
John E. Lamar and Thomas D. Johnson, Jr. (Planning Research Corp., Hampton, Va.) Jun. 1988 80 p Original contains color illustrations
(NASA-TP-2818; L-16395; NAS 1.60:2818) Avail: NTIS HC A05/MF A01 CSCL 01A

A flight test was undertaken at NASA Langley Research Center with vapor-screen and image-enhancement techniques to obtain qualitative and quantitative information about near-field vortex flows above the wings of fighter aircraft. In particular, the effects of Reynolds and Mach numbers on the vortex system over an angle-of-attack range were sought. The relevance of these flows stems from their present and future use at many points in the flight envelope, especially during transonic maneuvers. The aircraft used in this flight program was the F-106B because it was available and had sufficient wing sweep (60 deg) to generate a significant leading-edge vortex system. The sensitivity of the visual results to vapor screen hardware and to onset flow changes is discussed.
Author

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N88-23761 Civil Aviation Authority, London (England).
UK AIRMISS STATISTICS
1987 9 p
(CAA-1/87; CAP-526; ISBN-0-86-039302-X; ISSN-0951-6301; ETN-88-92503) Copyright Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, England 1 pound

Airmiss statistics from 1976 to April 1986 for United Kingdom airspace are presented. ESA

N88-23716*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY, 1986
Robert W. Simpson *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 3-6 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01C

N88-23717*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IN-FLIGHT MEASUREMENT OF ICE GROWTH ON AN AIRFOIL USING AN ARRAY OF ULTRASONIC TRANSDUCERS
R. John Hansman, Jr., Mark S. Kirby, Robert C. McKnight, and Robert L. Humes (Calspan Corp., Arnold AFS, Tenn.) *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 7-15 Sponsored in cooperation with FAA (For primary document see N88-23715 17-01)
(Grants NGL-22-009-640; NAG3-666)
(AIAA-Paper-87-0178) Avail: NTIS HC A06/MF A01 CSCL 01C

N88-23719*# Ohio Univ., Athens. Dept. of Electrical Engineering.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT OHIO UNIVERSITY, 1986
Richard H. McFarland *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 29-31 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01C

N88-23724*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT PRINCETON UNIVERSITY, 1986
Robert F. Stengel *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 61-69 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01F

N88-23727*# Princeton Univ., N. J.
FLIGHT PENETRATION OF WIND SHEAR: CONTROL STRATEGIES
Amit S. Joshi *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 107-117 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01F

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N88-23720*# Ohio Univ., Athens. Avionics Engineering Center.
LORAN-C MONITOR CORRELATION OVER A 92-MILE BASELINE IN OHIO
Robert W. Lilley and Jamie S. Edwards *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 33-40 (For primary document see N88-23715 17-01)
(Contract DTRS-57-83-C-00097)
Avail: NTIS HC A06/MF A01 CSCL 17G

N88-23722*# Ohio Univ., Athens.
INTEGRATED MULTISENSOR NAVIGATION SYSTEMS
Frank vanGraas *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 45-50 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 17G

N88-24262# General Electric Co., Philadelphia, Pa. Space Systems Div.
SPACE BASED RADAR APPLICATION TO AIR TRAFFIC CONTROL
William J. Caime *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 31-33 (For primary document see N88-24254 17-73)
(Contract JPL-956969)
Avail: NTIS HC A22/MF A01

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N88-23762*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT TESTING A V/STOL AIRCRAFT TO IDENTIFY A FULL-ENVELOPE AERODYNAMIC MODEL
B. David McNally and Ralph E. Bach, Jr. May 1988 16 p
(NASA-TM-100996; A-88139; NAS 1.15:100996) Avail: NTIS HC A03/MF A01 CSCL 01C

Flight-test techniques are being used to generate a data base for identification of a full-envelope aerodynamic model of a V/STOL fighter aircraft, the YAV-8B Harrier. The flight envelope to be modeled includes hover, transition to conventional flight and back to hover, STOL operation, and normal cruise. Standard V/STOL procedures such as vertical takeoff and landings, and short takeoff and landings are used to gather data in the powered-lift flight regime. Long (3 to 5 min) maneuvers which include a variety of input types are used to obtain large-amplitude control and response excitations. The aircraft is under continuous radar tracking; a laser tracker is used for V/STOL operations near the ground. Tracking data are used with state-estimation techniques to check data consistency and to derive unmeasured variables, for example, angular accelerations. A propulsion model of the YAV-8B's engine and reaction control system is used to isolate aerodynamic forces and moments for model identification. Representative V/STOL flight data are presented. The processing of a typical short takeoff and slow landing maneuver is illustrated. Author

N88-23763*# Boeing Commercial Airplane Co., Seattle, Wash.
INTEGRATED APPLICATION OF ACTIVE CONTROLS (IAAC) TECHNOLOGY TO AN ADVANCED SUBSONIC TRANSPORT PROJECT: PROGRAM REVIEW Contractor Report, Oct. 1978 - Nov. 1984
Washington NASA Mar. 1986 111 p
(Contract NAS1-15325)
(NASA-CR-3880; NAS 1.26:3880; D6-52151) Avail: NTIS HC A06/MF A01 CSCL 01C

This report summarizes the Integrated Application of Active Controls (IAAC) Technology to an Advanced Subsonic Transport Project, established as one element of the NASA/Boeing Energy Efficient Transport Technology Program. The performance assessment showed that incorporating ACT into an airplane designed to fly approximately 200 passengers approximately 2,000 nmi could yield block fuel savings from 6 to 10 percent at the design range. The principal risks associated with incorporating these active control functions into a commercial airplane are those involved with the ACT system implementation. The Test and Evaluation phase of the IAAC Project focused on the design, fabrication, and test of a system that implemented pitch axis fly-by-wire, pitch axis augmentation, and wing load alleviation. The system was built to be flight worthy, and was planned to be experimentally flown on the 757. The system was installed in the Boeing Digital Avionics Flight Controls Laboratory (DAFCL), where open loop hardware and software tests, and a brief examination of a direct drive valve (DDV) actuation concept were accomplished. The IAAC Project has shown that ACT can be beneficially incorporated into a commercial transport airplane. Based on the results achieved during the testing phase, there appears to be no fundamental reason(s) that would preclude the commercial application of ACT, assuming an appropriate development effort is included. Author

N88-23764# General Accounting Office, Washington, D. C.
NATIONAL AERO-SPACE PLANE: A TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROGRAM TO BUILD THE X-30
Apr. 1988 80 p
(GAO/NSIAD-88-122) Avail: NTIS HC A05/MF A01

The National Aero-Space Plane (NASP) Program is a joint DOD/NASA technology development and demonstration program to build and test the X-30 experimental flight vehicle. The X-30 is designed to take off horizontally from a conventional runway, reach hypersonic speeds up to Mach 25, attain low Earth orbit, and return to land on a conventional runway. The X-30 would fly 10 times faster and higher than existing air-breathing aircraft. The NASP Program is described and a status report of X-30 development provided, including the following: (1) goals and objectives; (2) program costs and schedule estimates; (3) key technological developments, integration, and risks; (4) potential military, space, and commercial mission applications; (5) program management and acquisition; and (6) alternatives and international aerospace development efforts. Author

N88-23765* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MULTI-BODY AIRCRAFT WITH AN ALL-MOVABLE CENTER FUSELAGE ACTIVELY CONTROLLING FUSELAGE PRESSURE DRAG Patent
Richard M. Wood, inventor (to NASA) 5 Apr. 1988 7 p Filed 12 Feb. 1987 Supersedes N87-25320 (25 - 19, p 2571)
(NASA-Case-LAR-13511-1; US-Patent-4,735,381;
US-Patent-Appl-SN-013801; US-Patent-Class-244-130;
US-Patent-Class-244-119; US-Patent-Class-244-120;
US-Patent-Class-244-15) Avail: US Patent and Trademark Office CSCL 01C

A multi-body aircraft with an all-movable center fuselage which translates relative to two side fuselages is described. At subsonic and transonic flight the center fuselage is in a forward position. At supersonic speeds the center fuselage moves aft so as to ensure optimum aerodynamic interference at particular Mach numbers. This provides an increased shock strength and greater

surface areas so the significant reductions in zero-lift wave drag can be achieved. This concept allows for a significant increase in the wing aspect ratio which would improve high-lift performance at all speeds without incurring a significant supersonic zero-lift wave drag penalty. In addition to an improved low-fineness ratio, high-speed performance is achieved at all speeds and for all flight conditions.

Official Gazette of the U.S. Patent and Trademark Office

N88-23766*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SENSITIVITY ANALYSIS AND MULTIDISCIPLINARY OPTIMIZATION FOR AIRCRAFT DESIGN: RECENT ADVANCES AND RESULTS
Jaroslaw Sobieszczanski-Sobieski Jul. 1988 14 p Presented at the 16th Congress of the International Council of the Aeronautical Sciences, Jerusalem, Israel, 28 Aug. - 2 Sep. 1988
(NASA-TM-100630; NAS 1.15:100630) Avail: NTIS HC A03/MF A01 CSCL 01C

Optimization by decomposition, complex system sensitivity analysis, and a rapid growth of disciplinary sensitivity analysis are some of the recent developments that hold promise of a quantum jump in the support engineers receive from computers in the quantitative aspects of design. Review of the salient points of these techniques is given and illustrated by examples from aircraft design as a process that combines the best of human intellect and computer power to manipulate data. Author

N88-23726*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
IT'S TIME TO REINVENT THE GENERAL AVIATION AIRPLANE
Robert F. Stengel *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 81-105 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01C

N88-23744*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLIGHT EXPERIENCES WITH LAMINAR FLOW
Bruce J. Holmes *In its* Laminar Flow Aircraft Certification May 1986 p 155-169 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01C

N88-23746*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRELIMINARY AERODYNAMIC DESIGN CONSIDERATIONS FOR ADVANCED LAMINAR FLOW AIRCRAFT CONFIGURATIONS
Joseph L. Johnson, Jr., Long P. Yip, and Frank L. Jordan, Jr. *In its* Laminar Flow Aircraft Certification May 1986 p 185-225 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01C

N88-23748*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPERATIONAL CONSIDERATIONS FOR LAMINAR FLOW AIRCRAFT
Dal V. Maddalon and Richard D. Wagner *In its* Laminar Flow Aircraft Certification May 1986 p 247-268 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01C

N88-23749*# Federal Aviation Administration, Kansas City, Mo. Small Airplane Certification Directorate.
CERTIFICATION ASPECTS OF AIRPLANES WHICH MAY OPERATE WITH SIGNIFICANT NATURAL LAMINAR FLOW
Edward A. Gabriel and Earsa L. Tankesley *In* NASA, Langley Research Center, Laminar Flow Aircraft Certification May 1986 p 269-277 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 01C

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N88-23767# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Avionics Panel.
THE DESIGN, DEVELOPMENT AND TESTING OF COMPLEX AVIONICS SYSTEMS
Dec. 1987 408 p In ENGLISH and FRENCH Symposium held in Las Vegas, Nev., 27 Apr. - 1 May 1987
(AGARD-CP-417; ISBN-92-835-0437-2) Copyright Avail: NTIS HC A18/MF A01

The design, development and testing of complex avionics systems are discussed. Design aspects for future avionics systems, managing the future system design process, and system design tools and integration are among the topics covered. For individual titles, see N88-23768 through N88-23804.

N88-23768*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TECHNOLOGY DEVELOPMENT PROGRAM FOR TWENTY-FIRST CENTURY AEROSPACE VEHICLES
William T. Suit and Douglas B. Price *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 6 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01 CSCL 01D

A program to meet the avionics technology needs for the design of future space transportation systems is presented. The program is designed to meet as many technology goals as possible by 1996 so decisions can be made as to which vehicles are feasible and which should be constructed. Author

N88-23769# Naval Air Development Center, Warminster, Pa.
SYSTEMS FOR THE 21ST CENTURY
Richard G. DeSipio *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 7 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

An avionic system index is proposed which allows for the definition of each function of the avionics system. The results of two demonstrations relative to the exploitation of on-board avionics built-in-test and diagnostics are presented. Author

N88-23770# Thomson-CSF, Malakoff (France).
ARCHITECTURE AND ROLE OF THE SENSOR SUBSYSTEM IN FUTURE AIRCRAFT WEAPON SYSTEMS
J. A. Salmon, C. J. C. Ravat, and F. J. Lork *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 6 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Today, in military aircraft systems, each external sensor (radar, ESM, electro-optical equipment, radio communications) is almost independent and reports to the central computer. Taking into account the evolution of operational context in which the aircraft is involved and the dramatic progress in processing capabilities, it appears necessary and possible to spread the intelligence aspect of the weapon system in order to optimize the global cost efficiency. This distribution enables each specialist to concentrate his efforts in order to take advantage of the ever increasing scope of knowledge associated with each discipline. Here, the sensor subsystem is dealt with, its architecture is defined and its function in the aircraft system is described. Author

N88-23771# Aeritalia S.p.A., Caselle Torinese (Italy). Gruppo Sistemi Avionici ed Equipaggiamenti.
RAPID PROTOTYPING OF COMPLEX AVIONIC SYSTEM ARCHITECTURES
L. Berardi, N. Giorgi, W. Mellano, A. Valente, and E. Zucco *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 13 p Sponsored in part by

Unisys, Italy (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

A design tool called Expert Consultant for Avionics system Transformation Exploration (ECATE) is described. ECATE, rapidly prototyping different alternatives, helps the designer in establishing the information flow architecture of the avionics system, that is, the organization of the internal data handling. The tool provides the user with an interface to assist him in describing the avionics from the point of view of the data handling and presents the results in a suitable format. It performs consistency checks and advises the user on possible architectural problems by means of expert system techniques. Author

N88-23772# British Aerospace Public Ltd. Co., Woodford (England). Civil Aircraft Div.
THE SPECIFICATION AND DESIGN OF A FUTURE MARITIME RECONNAISSANCE AIRCRAFT
J. Shepard *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 11 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The problems of providing specifications for system components of the highly integrated avionic systems of the future are discussed in the context of the avionics systems of a Future Maritime Reconnaissance Aircraft (FMRA). The need and extent of the integration of the avionic systems are discussed, as are the consequences for system definition and specification. Potential techniques for addressing these problems are reviewed. These are brought together to describe an approach which could provide the tools required. The implication of this approach for vendors and integrators is addressed. Author

N88-23773# British Aerospace Aircraft Group, Preston (England). Military Aircraft Div.
A STRUCTURED APPROACH TO WEAPON SYSTEM DESIGN
H. M. Malley, N. T. Jewell, and R. A. C. Smith *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 12 p Sponsored in part by the Ministry of Defence, United Kingdom (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

A structured approach to the design of highly integrated weapon systems of the future is described. The approach was used in the design of the avionics system for the UK Experimental Aircraft Program (EAP) demonstrator aircraft. Brief descriptions are given of the EAP systems, the main systems design tools used, the activities carried out during the systems design process and the management and control procedures adopted. A series of observations highlighting some of the findings of the project and providing pointers to the design of future weapon systems is given. Author

N88-23774# International Business Machines Corp., Owego, N.Y. Federal Systems Div.
DEVELOPMENT OF A GENERIC ARCHITECTURE
Christina Berggren *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 5 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

A new generation systems architecture is designed to bridge the gap between today's 1553-based systems and fault-tolerant, totally integrated systems of tomorrow. Described here is a novel approach to system functional area partitioning and the design of this generic distributed real time architecture. The architecture incorporates new military standards in development. Author

N88-23775# Agusta Sistemi S.p.A., Varese (Italy).
TEST PHILOSOPHY OF THE EH101 INTEGRATED AVIONIC
E. Galli *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 5 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The philosophy employed during the development and testing of the EH101 integrated avionic Navel helicopter is outlined. The avionics architecture is given in graphic form. Overall avionic integration, the aircraft management computer test, the sensor interface units test, and the aircraft management system test are described. Author

N88-23776# International Business Machines Corp., Owego, N.Y. Federal Systems Div.
SYSTEMS ENGINEERING TECHNIQUE
Leonard Karas and Donna Rhodes *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 9 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

An overview is given of the Systems Engineering Technique (SET). SET was developed to effect an improvement in quality and productivity aspects in the development of avionics systems. The methodology synthesizes the best features of existing development methodologies into a single core procedure which is equally applicable throughout the systems development phases of complex systems. Six key areas emphasized by SET are discussed, and the concept of systems engineering measurements is introduced as the means to evaluate system quality and productivity. SET is being applied to the development of avionics systems at IBM Owego and has been effective in improving specification quality. Author

N88-23777# Avions Marcel Dassault, Saint-Cloud (France).
MODELING OF FUNCTIONAL SPECIFICATIONS FOR ONBOARD SOFTWARE: EXPERIENCE WITH THE RAFALE AVIONICS SYSTEM [MAQUETTAGE DES SPECIFICATIONS FONCTIONNELLES DU LOGICIEL EMBARQUE EXPERIENCE DU SYSTEME AVIONIQUE RAFALE]
Patrick Schirle *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 12 p In FRENCH (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The avionics system of the Rafale aircraft entailed innovations such as the integration of aircraft systems and the acquisition of control information. These new functions resulted in a notable increase in, and qualitative evolution of, onboard computer software. For the improvement of quality and response characteristics of software, development was supported by an integral methodology for modeling software functional specifications. The model was constructed around a SEL computer supporting a FORTRAN listing of 3500 pages of system functional specifications. The model allows the direct validation of each individual specification and the whole ensemble of specifications. The model was used to support the analysis of the system failures, provide a base for the assessment of modifications, generate acceptance rules, and prepare a functional reference for integration. Author

N88-23778# International Business Machines Corp., Owego, N.Y.
THE AVIONICS SOFTWARE ARCHITECTURE IMPACT ON SYSTEM ARCHITECTURE
C. Douglass Locke *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 5 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Technology developments that led to the problem of system vulnerability to software errors resulting from increased avionic system complexity and the impact of these developments on the functionality and design of new systems are considered. The current sequence for performing the physical and software architectural design, including a definition of the software architecture is discussed. The likely consequences of using these methods for designing new avionics systems are also discussed. Author

N88-23779# Litton Technische Werke, Freiburg (West Germany).
A COMPARISON OF INTEGRATED AND SEPARATE SYSTEMS FOR FLIGHT CONTROL AND NAVIGATION
H. Buitkamp *In* AGARD, The Design, Development and Testing

of Complex Avionics Systems Dec. 1987 10 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Two steps for the integration of flight control sensors, the Altitude and Heading Reference System (AHRS) and the Inertial Navigation System (INS) are discussed. It has been shown that the use of the same sensors for flight control and AHRS functions, as for example in the Aircraft Motion Sensor Unit (AMSU) system, yield excellent results. The AMSU system has demonstrated its performance capability in the Experimental Aircraft Program (EAP) inherently unstable aircraft. These aircraft, as opposed to conventional aircraft, require inertial sensor data with an extremely high bandwidth and very small data latency for flight control purposes. Author

N88-23780# Textron Bell Helicopter, Fort Worth, Tex. Advanced Human Factors System Design.
DEVELOPMENT AND TESTING OF A PREDICTIVE METHODOLOGY FOR OPTIMIZATION OF MAN-MACHINE INTERFACE IN FUTURE AVIONICS SYSTEMS
Roger E. Parks *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 9 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The trend toward increasing complexity and cost in emerging avionics systems, driven by requirements for increased functional capability, has created a need for a predictive analytical methodology which accurately forecasts system performance early in the design process, and treats the human operator and the equipment as a fully integrated man-machine system. A methodology that meets these needs has been developed and validated by Bell Helicopter Textron. The process is being used to provide early, accurate avionics system characterization, thereby reducing design costs. Author

N88-23781# Boeing Military Airplane Development, Wichita, Kans.
CREWSTATION INFORMATION AND DEVELOPMENT SYSTEM (CIDS)
M. E. Rowland and W. R. Wagoner *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 11 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The process by which requirements for an avionics system are translated into an integrated crewstation design is discussed. The Crewstation Information Development System (CIDS) was divided into three phases of activity. In Phase 1, methodology development, a comprehensive set of requirements, resource allocation, and an information utilization assessment is derived. Phase 2, crewstation development, focuses on deriving the most effective methods of utilizing required crewstation information, taking into consideration the impact of the operational environment. The final phase, design application, concerns the details of crewstation design and the development of a crewstation information manager. Author

N88-23782# Naval Air Development Center, Warminster, Pa.
A CHANGE IN SYSTEM DESIGN EMPHASIS: FROM MACHINE TO MAN
M. L. Metersky and J. L. Ryder (Pacer Systems, Inc., Horsham, Pa.) *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 9 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Even though software has increased in importance and percentage of cost in system development, it is still philosophically considered as a means to facilitate hardware performance. This thinking has had an adverse effect on system performance by relegating decision requirements to a minor or nonexistent role in the system design process. It is the premise here that system design should be dictated by decision requirements, since decisions humans make determine how well and to what degree a weapon system's inherent capabilities will be utilized. A system design approach based on an emphasis of the human's role as a decision maker is presented. Author

N88-23783# Northrop Corp., Hawthorne, Calif. ASET Development.
MANAGING ADVANCED AVIONIC SYSTEM DESIGN
Philip H. Simons *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 8 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The critical requirements of advanced avionic system design are overall system requirements, configuration item requirements, interface requirements, and design process management requirements. These requirements can be met through the design process of abstract requirements definition, requirements/functional decomposition, functional recomposition, and detailed interface definition. This process can be greatly aided by computer automation, resulting in the design of more complex avionics systems in far less time than would be possible using older tools. Author

N88-23784# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France). Lab. Central de Biologie Aerospatiale.
PSYCHOSENSORY COCKPIT ERGONOMICS, ADVANTAGES OF INTELLIGENT INFORMATION SYSTEMS [ERGONOMIE PSYCHOSENSORIELLE DES COCKPITS, INTERET DES SYSTEMES INFORMATIQUES INTELLIGENTS]
R. Amalberti, F. Deblon, and J. P. Menu *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 12 p In FRENCH; ENGLISH summary (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Psychosensory cockpit ergonomics consists of a pluridisciplinary approach focused on global consideration of man-machine interface issues. Knowledge supplied by each research field (sensory physiology, cognitive psychology, design of intelligent systems) is used in every concrete approach, taking into consideration aviation requirements and technological advances. Requirements that must be met to build such systems and computer system goals are discussed. Author

N88-23785# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
ADVANCED DEVELOPMENT OF A COCKPIT AUTOMATION DESIGN SUPPORT SYSTEM
Philip V. Kulwicki, Joe W. McDaniel, and Lisa M. Guadagna *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 15 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

A highly disciplined and structured crew system design process is being developed to improve the efficiency and effectiveness by which advanced cockpits can be fielded. As an initial implementation of the CAT design process, a Cockpit Automation Design Support System (CADSS) is being developed to provide a computer aided design environment, including the software design tools amd the simulation utilities that can facilitate the development of the crew system in synchrony with the development of the avionics and weapon system. The rationale underlying the CADSS is described in terms of the system components, which include a Designer's Computer Aided Design System (DCADS) processor, new software tools and a breadboard cockpit simulator which are envisioned to complement, but not replace, existing development facilities. This implementation of the cockpit design support system is described in relation to the overall CAT program activities and schedule. Author

N88-23786# Societe Nationale Industrielle Aerospatiale, Marignane (France). Div. Helicopteres.
DESIGN AND DEVELOPMENT OF AN AVIONICS SYSTEM ADAPTED TO HELICOPTER MISSIONS [CONCEPTION ET DEVELOPPEMENT D'UN SYSTEME AVIONIQUE ADAPTE AUX MISSIONS DES HELICOPTERES]
Daniel Bouheret and Jean Louis Roch (Crouzet Aerospace and Systems, Valence, France) *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 16 p In FRENCH (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The development of the avionics system for the Dauphin 365 F configured for search and rescue operations is discussed. A general description of flight missions and system architecture is presented with particular emphasis being given to the navigation and mission management subsystems. The system is based on a Nadir Mk2 microprogrammable computer capable of an execution rate of 1 MOPS. The interactive relationship between the system designers and integrators is described along with the design support tools that aid in achieving successful interaction. Author

N88-23787# Hughes Aircraft Co., Fullerton, Calif.
OPERATION AND PERFORMANCE OF AN INTEGRATED HELICOPTER COMMUNICATION SYSTEM
Walter R. Fried *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 8 p Previously announced in IAA as A87-31469 (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The unique operational and performance requirements of the communication system for modern tactical Army helicopters are described. An integrated system architecture is described which satisfies these requirements and incorporates very high levels of automation, thereby reducing pilot workload. The automation concepts include the use of a preloaded communication data base and a centralized communication processor containing advanced control, reconfiguration and message formatting software. Link analysis and simulation results are presented to show the performance capabilities of the system with respect to the projected mission requirements. Author

N88-23788# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Human Engineering Div.
DESIGNING FOR DESIGN EFFECTIVENESS OF COMPLEX AVIONICS SYSTEMS
Kenneth R. Boff *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 9 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The Integrated Perceptual Information for Designers (IPID) Project is a multiagency supported effort to aid the accessibility and use of human performance data in system design. It is formulated around five information management objectives: (1) identifying, collecting, and consolidating human performance data of potential value to system design; (2) human factoring these data to enable their direct use by system designers; (3) establishing an institute with responsibility for maintenance, update and analysis of these resources to support crew system design; (4) developing and sponsoring educational opportunities to train and sensitize system designers in the value and application of human performance data to crew system design; and (5) conducting exploratory research to define and evaluate requirements for an automated design support capability to aid engineers to access and tradeoff human performance data with other technical information germane to the effective design of crew systems. Author

N88-23789# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
DESIGN FOR INTEROPERABILITY (INTERCHANGEABILITY)
George Konomos *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 5 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Interoperability of the various elements used in a system is the design property which allows the intermixing of elements from various sources (manufactures) without any impact on the performance of the system or the operational hardware. Here, the line replaceable module approach is discussed. This is a new approach to avionics where a processor module is a 6 inch by 6 inch plug-in board with processing power many times higher than that of older line replaceable units. Author

N88-23790# Aeritalia S.p.A., Caselle Torinese (Italy). Gruppo Equipaggiamenti.
THE ELECTROMAGNETIC THREAT TO FUTURE AVIONIC SYSTEMS
Bruno Audone *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 10 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The electromagnetic threat to future aircraft is studied and evaluated on the basis of the evolution of the avionic systems. The high level of integration of these systems combined with the increased number of electromagnetic sources which may interfere with the performance of the overall weapon system create the need to reexamine the usual design and testing approach in order to reach an adequate level of aircraft hardening. It is essential to design and test at system level rather than at hardware level. System design guidelines are discussed. Areas where basic research studies need to be undertaken are highlighted. Author

N88-23791# Thorn EMI, Hayes (England). Radar Div.
THE INTEGRATION, CHARACTERISATION AND TRIALLING OF A MODERN COMPLEX AIRBORNE RADAR
Roger Roy Hogben and Frank N. Morphet *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 5 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The process of commissioning, testing and conducting trials of complex aircraft radar is discussed. An attempt is made to show how vital an informed and methodical approach is to achieving success. It is argued that it is essential to the approach that higher management understands and supports it. Author

N88-23792# Naval Weapons Center, China Lake, Calif. Microelectronics Branch.
MICROELECTRONICS THE NEXT FIFTEEN YEARS **c33**
Dean Wallace *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 5 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Some future trends in microelectronics are predicted. The focus is on CMOS integrated circuit technology. CMOS is presently the leading integrated circuit technology, and all trends show that it will continue to dominate the integrated circuit market in the future. Twin tub and silicon on insulator (SOI), identified as the two leading CMOS technologies in the future, are examined. These two technologies have the capability of giving maximum CMOS device performance. With device geometries shrinking, the problems associated with scaling are introduced, and some possible solutions are examined. A brief description is given of some fundamental limits in integrated circuit technology. Author

N88-23793# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario). Human Engineering Section.
EXPERIENCE IN THE INTEGRATION OF HUMAN ENGINEERING EFFORT WITH AVIONICS SYSTEMS DEVELOPMENT
D. Beevis *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 9 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Based on a review of human engineering activities in ten major acquisition projects, some conclusions aimed at facilitating the

integration of human engineering activities with the development of advanced avionics are outlined. Conclusions are also drawn about the systems design and human engineering processes, and the role that mission, function, and task analysis can play in integrating human engineering and systems development activities. It is concluded that an approach that combines the interaction of hardware, software, and human functions is made especially necessary by the impact of advanced technology on the roles of human operators and maintainers, on the man-machine interface, and on the system development process itself. Finally, it is argued that there is a need to establish standardized approaches to the application of human engineering in avionics system design.
Author

N88-23794# Electronique Serge Dassault, St. Cloud (France).
TESTING COMPLEX AVIONICS SOFTWARE: A PRACTICAL EXPERIENCE [LE TEST DE LOGICIELS AVIONIQUES COMPLEXES: UNE EXPERIENCE PRATIQUE]
M. Muenier *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 16 p In FRENCH (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The methods used at Dassault for testing avionics software, particularly the operational programs used on the Mirage F1 and Mirage 2000 aircraft, are presented. The MINERVE software development methodology is briefly described. The objective of MINERVE is to facilitate software production while ensuring control of quality, costs and development delays. The various software tools used to perform unitary, integration, functional and final software validation and testing are described. These tools provide hardware environment simulation, graphic output and various operational modes. A trend towards the integration of front-end tools (specification tools) and back-end tools (test tools) is noted and a natural progression from specification tool to semiformal specification, to prototype, to stimuli, to test tools is foreseen.
Author

N88-23795# Naval Weapons Center, China Lake, Calif.
DEVELOPING SYSTEMS USING STATE-OF-THE-ART CAD/CAM TECHNOLOGY **c61**
Vernon A. Anderson and David J. Brewer (Space and Naval Warefare Systems Command, Charleston, S.C.) *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 7 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Here, state-of-the-art CAD-CAM refers to mission-specific applications with the ability to describe a design that is independent of technology at certain levels; that is, which describes a design in a manner independent of any particular implementation, yet allows integrated verification across design boundaries. Such a high-level approach pays high dividends in transferring designs from one technology to another. Presented here are some structures useful for improving understanding of technology, systems, CAD/CAM, and communications across interfaces. A technology planning and communications framework concerning a hierarchical system schema is introduced for looking at the spectrum of user tasks in the life cycle of electronic products. The Navy's acquisition strategy and plans for computer-aided design/computer-aided manufacturing are presented. Author

N88-23796# Naval Postgraduate School, Monterey, Calif. Dept. of Computer Science.
INTERFACING AND INTEGRATING HARDWARE AND SOFTWARE DESIGN SYSTEMS
Daniel Davis *In* AGARD, The Design, Development and Testing of Complex Avioncs Systems Dec. 1987 8 p Sponsored in part by the Naval Weapons Center, China Lake, Calif., and the Naval Ocean Systems Command, San Diego, Calif. (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Fundamental problems in interfacing and integrating information between diverse design systems are examined. Specifically, design problems associated with the contexts of meaning that are required to understand information in diverse systems are examined. Increased research into a general theory of design is advocated. The resolution to some integration problems is suggested on the basis of some recent developments and experience with a functional design theory.
Author

N88-23797# Air Force Test Pilot School, Edwards AFB, Calif.
A LOOK TOWARD THE FUTURE OF COMPLEX AVIONICS SYSTEMS DEVELOPMENT USING THE USAF TEST PILOT SCHOOL'S AVIONICS SYSTEMS TEST TRAINING AIRCRAFT
William H. Broome, Jr. and Mike Parrag (Calspan Corp., Buffalo, N. Y.) *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 16 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The Avionics Systems Test Training Aircraft (ASTTA) is a special configuration of the NC-131H Total In-flight Simulator (TIFS), and was developed to fill a significant gap in the education and experience of the avionics systems test community. It provides a cost effective means of quickly exposing both designers and testers to the key issues of systems development and in-flight testing, especially the operator to systems interface human factors issues. Its benign flight environment is conducive to both initial and advanced training in flight test techniques.
Author

N88-23798# British Aerospace Public Ltd. Co., Preston (England). Military Aircraft Div.
SOFTWARE ENGINEERING FOR THE BRITISH AEROSPACE EXPERIMENTAL AIRCRAFT PROGRAMME (EAP) **c61**
W. E. R. Kellaway *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 14 p Sponsored in part by the Ministry of Defence, United Kingdom (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The software engineering approach adopted by British Aerospace in the specification, design and implementation of the Avionics and Utility Systems Management software for the Experimental Aircraft Program (EAP) is described. The software life cycle and supporting methods and tools are described, in particular the Controlled Requirements Expression (CORE) method, supported by the CORE Work Station, and the PERSPECTIVE programming support environment. The considerable benefits obtained in both productivity and quality are highlighted and developments leading to a full Integrated Project Support Environment (IPSE) are indicated.
Author

N88-23799# Avions Marcel Dassault, Saint-Cloud (France).
AVIONICS SYSTEMS: DEVELOPMENT METHOD AND COMPUTER TOOLS [SYSTEME AVIONIQUE-METHODE DE DEVELOPPEMENT ET OUTILS INFORMATIQUES]
P. Laroche-Levy *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 13 p In FRENCH (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The avionics development system based on the use of computer automation tools is described. The problems posed in the development of avionics are defined and the various phases constituting the development life cycle for avionics systems are characterized. The capabilities of the computer tools and how they are used in various development stages are described. Finally, the benefits gained through the use of such a development methodology are discussed.
Author

N88-23800# General Research Corp., Santa Barbara, Calif.
A SOFTWARE LIFE CYCLE SUPPORT ENVIRONMENT **c61**
L. Y. Bajwa and Frank S. LaMonica (Rome Air Development Center, Griffiss AFB, N.Y.) *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 19 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The Software Life Cycle Support Environment (SLCSE) is a distributed , computer-based environment of software development

tools and methods which span the full spectrum of the software life cycle and are integrated through a common and consistent user interface and a life cycle project data base. Primary features of the SLCSE are: (1) it supports both the development and management of complex mission-critical computer resources (MCCR) software systems; (2) it is multilingual, supporting the Air Force standard higher order languages including MIL-STD-1589B (JOVIAL J73) and MIL-STD-1815A (Ada); and (3) through its unifying framework, it enables the integration of both newly developed and existing software tools. The SLCSE development effort, highlights of SLCSE architecture, requirements and top-level design are discussed. The implementation appproach is described along with the results of the first build. Testing and verification plans are discussed and risk areas identified. Long-term plans to evolve the SLCSE beyond the current contractual requirements are discussed. Author

N88-23801# National Aerospace Lab., Amsterdam (Netherlands).
DEVELOPMENT OF AN AIRBORNE FACILITY FOR ADVANCED AVIONICS RESEARCH
N. vanDriel *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 14 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

Based on its flight test and simulator experience, the Netherlands National Aerospace Laboratory (NLR) has started the development of an airborne avionics research facility. In the framework of the Avionics Research Testbed (ART) project, NLR's Metro research airplane is being equipped with a number of advanced avionics systems, including programmable electronic flight instrument system, flight management computer, microwave landing system, global positioning system and secondary surveillance radar. Author

N88-23802# Avions Marcel Dassault, Saint-Cloud (France). Aerospatiale Div. Helicopteres.
WORKSHOPS FOR THE DESIGN OF AVIONICS SYSTEMS AND THE DEVELOPMENT OF ONBOARD SOFTWARE [ATELIERS DE CONCEPTION DE SYSTEMES AVIONIQUES ET DE REALISATION DE LOGICIELS EMBARQUES]
Monique Slissa and Philippe Laroche-Levy *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 13 p In FRENCH (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

An avionics development system based on an open-ended suite of integrated computer tools is described. Additions and changes to the basic tool set can be implemented to suit the requirements of the specific project or individual contractor. A hosting structure tool that ties the whole system together is described along with three other basic tools: OCS, a system design aid; DLAO, a computer aided software definition tool; and SAO, a graphic, detailed specification aid. Author

N88-23803# Rockwell International Corp., Lakewood, Calif. Aircraft Operations.
COHERENT FUNCTIONAL DEVELOPMENT: KEY TO SUCCESSFUL FUTURE SYSTEM INTEGRATION **c81**
Bruce L. House *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 22 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

An advanced, computer based engineering design methodology and tool set which enables and enhances complex system, subsystem and component design, analysis, integration and verification/validation testing in an operational context is described. When fully implemented, functional development by means of manipulation of coherently derived time-line state data, in a dynamic, high fidelity and operational contex, will enable concurrent, fully integrated, rapid prototyping and subsequent detailed design synthesis of the avionics, vehicle, weapons and crew systems components of a total weapon system. Author

N88-23804# Service Techniques des Programmes Aeronautiques, Paris (France).
DEVELOPMENT OF COMPLEX AVIONICS SYSTEMS: EXPERIENCE FROM FRENCH MILITARY PROGRAMS [DEVELOPPEMENT DES SYSTEMES AVIONIQUES COMPLEXES: EXPERIENCE ISSUE DES PROGRAMMES MILITAIRES FRANCAIS]
Antoine Coursimault *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 15 p In FRENCH (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

The principles used to guide the development of the avionics systems for the Mirage 2000 and ATL2 aircraft are discussed. In addition, the anomalies discovered during these development experiences and improvements contributing to the current ACT program are examined. The various development, verification, and production stages are characterized. Emphasis is placed on the importance of requirements analysis and specifications development. Author

N88-23721*# Ohio Univ., Athens.
DATAC BUS MONITOR
Stanley M. Novacki, III and Robert J. Thomas, Jr. *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 41-43 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01D

N88-23723*# Ohio Univ., Athens.
INTEGRATED AVIONICS RELIABILITY
Dimitri Alikiotis *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 51-59 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01D

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N88-23805*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
AUGMENTOR PERFORMANCE OF AN F100 ENGINE MODEL DERIVATIVE ENGINE IN AN F-15 AIRPLANE
James T. Walton and Frank W. Burcham, Jr. May 1986 21 p (NASA-TM-86745; H-1309; NAS 1.15:86745) Avail: NTIS HC A03/MF A01 CSCL 21E

The transient performance of the F100 engine model derivative (EMD) augmentor was evaluated in an F-15 airplane. The augmentor was a newly designed 16-segment augmentor. It was tested with a segment-1 sprayring with 90 deg fuel injection, and later with a modified segment-1 sprayring with centerline fuel injection. With the 90 deg injection, no-lights occurred at high altitudes with airspeeds of 175 knots or less; however, the results were better than when using the standard F100-PW-100 engine. With the centerline fuel injection, all transients were successful to an altitude of 15,500 meters and an airspeed of 150 knots: no failures to light, blowouts, or stalls occurred. For a first flight evaluation, the augmentor transient performance was excellent. Author

N88-23806*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE CHALLENGES AND OPPORTUNITIES OF SUPERSONIC TRANSPORT PROPULSION TECHNOLOGY
William C. Strack and Shelby J. Morris, Jr. (National Aeronautics and Space Administration. Langley Research Center, Hampton,

Va.) Jul. 1988 18 p Prepared for presentation at the 24th Joint Propulsion Conference, Boston, Mass., 11-13, Jul. 1988
(NASA-TM-100921; E-4178; NAS 1.15:100921; AIAA-88-2985)
Avail: NTIS HC A03/MF A01 CSCL 21E

The major challenges confronting the propulsion community for civil supersonic transport applications are identified: high propulsion system efficiency at both supersonic and subsonic cruise conditions, low-cost fuel with adequate thermal stability at high temperatures, low noise cycles and exhaust systems, low emission combustion systems, and low drag installations. Both past progress and future opportunities are discussed in relation to perceived technology shortfalls for an economically successful airplane that satisfies environmental constraints. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N88-23807*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONTROL LAW PARAMETERIZATION FOR AN AEROELASTIC WIND-TUNNEL MODEL EQUIPPED WITH AN ACTIVE ROLL CONTROL SYSTEM AND COMPARISON WITH EXPERIMENT
Boyd Perry, III, H. J. Dunn, and Maynard C. Sandford May 1988 18 p Presented at the AIAA/ASME/ASCE/AHS/ASC 29th Structures, Structural Dynamics, and Materials Conference in Williamsburg, Va., 18-20 Apr. 1988
(NASA-TM-100593; NAS 1.15:100593; AIAA-Paper-88-2211)
Avail: NTIS HC A03/MF A01 CSCL 01C

Nominal roll control laws were designed, implemented, and tested on an aeroelastically-scaled free-to-roll wind-tunnel model of an advanced fighter configuration. The tests were performed in the NASA Langley Transonic Dynamics Tunnel. A parametric study of the nominal roll control system was conducted. This parametric study determined possible control system gain variations which yielded identical closed-loop stability (roll mode pole location) and identical roll response but different maximum control-surface deflections. Comparison of analytical predictions with wind-tunnel results was generally very good. Author

N88-23808* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THREE AXIS ATTITUDE CONTROL SYSTEM Patent
Philip A. Studer, inventor (to NASA) 22 Mar. 1988 13 p Filed 7 Nov. 1985 Supersedes N86-20396 (24 - 11, p 1720)
(NASA-Case-GSC-12970-1; US-Patent-4,732,353;
US-Patent-Appl-SN-795805; US-Patent-Class-244-165) Avail: US Patent and Trademark Office CSCL 01C

A three-axis attitude control system for an orbiting body comprised of a motor driven flywheel supported by a torque producing active magnetic bearing is described. Free rotation of the flywheel is provided about its central axis and together with limited angular torsional deflections of the flywheel about two orthogonal axes which are perpendicular to the central axis. The motor comprises an electronically commutated DC motor, while the magnetic bearing comprises a radially servoed permanent magnet biased magnetic bearing capable of producing cross-axis torques on the flywheel. Three body attitude sensors for pitch, yaw and roll generate respective command signals along three mutually orthogonal axes (x, y, z) which are coupled to circuit means for energizing a set of control coils for producing torques about two of the axes (x and y) and speed control of the flywheel about the third (z) axis. An energy recovery system, which is operative during motor deceleration, is also included which permits the use of a high-speed motor to perform effectively as a reactive wheel suspended in the magnetic bearing.
Official Gazette of the U.S. Patent and Trademark Office

N88-23809* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HELICOPTER ANTI-TORQUE SYSTEM USING FUSELAGE STRAKES Patent
Henry L. Kelley, inventor (to NASA) and John C. Wilson, inventor (to NASA) 24 Nov. 1987 9 p Filed 30 Jan. 1987 Supersedes N87-23630 (25 - 17, p 2287)
(NASA-Case-LAR-13630-1; US-Patent-4,708,305;
US-Patent-Appl-SN-008895; US-Patent-Class-244-17.19;
US-Patent-Class-244-91) Avail: US Patent and Trademark Office CSCL 01C

The improvement of the helicopter torque control system is discussed. At low to medium forward speeds helicopter performance is limited by the effectiveness of the means for counteracting main rotor torque and controlling sideslip airloads. These problems may be overcome by mounting strakes on the aft fuselage section. For single rotor helicopters whose main rotor rotates counter-clockwise as viewed from above, one of the strakes would be mounted in the upper lefthand quadrant and the second in the lower left hand quadrant. The strakes alter the air flow around the fuselage by separating the flow so as to produce lateral airloads on the tail boom which oppose main-rotor torque. The upper strake operates in a right crosswind to oppose main rotor torque, and the lower strake has effect in left crosswinds. The novelty of this invention resides in the simple and economical manner in which the helicopter tail boom may be modified by the addition of strakes in order to increase torque control, and reduce the need for supplemental mechanical means of torque control.
Official Gazette of the U.S. Patent and Trademark Office

N88-23725*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
RULE-BASED FAULT-TOLERANT FLIGHT CONTROL
Dave Handelman *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 71-79 (For primary document see N88-23715 17-01)
Avail: NTIS HC A06/MF A01 CSCL 01C

N88-23747*# Vigyan Research Associates, Inc., Hampton, Va.
NATURAL LAMINAR FLOW AND AIRPLANE STABILITY AND CONTROL
Cornelis P. vanDam *In* NASA, Langley Research Center, Laminar Flow Aircraft Certification May 1986 p 227-245 (For primary document see N88-23737 17-02)
(Contract NAS1-17797)
Avail: NTIS HC A14/MF A01 CSCL 01C

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N88-23810# Systems Control Technology, Inc., Arlington, Va.
ANALYSES OF HELIPORT SYSTEM PLANS Final Report
Deborah Peisen and Jack Thompson Feb. 1988 95 p
(Contract DTFA01-87-C-00014)
(DOT/FAA/PM-87/31; DOT/FAA/PP-88/1; Rept-5542-6A2)
Avail: NTIS HC A05/MF A01

Strengths and weaknesses of various existing heliport system plans are analyzed. Planning concepts are identified and defined to include: (1) baseline parameters for evaluating the plans; (2) identifying data and their sources needed for planning purposes at any jurisdictional level; and (3) developing criteria for assessing the feasibility and economic viability of proposed heliport facilities. The study covers four state heliport system plans (Michigan, New Jersey, Louisiana, and Ohio) and four metropolitan heliport plans (Pittsburgh, Pa.; Phoenix, Ariz.; Houston, Tex.; and Washington, D.C.). Author

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N88-23811# Systems Designers Ltd., Camberley (England).
SOLID EARTH MISSION END-TO-END DATA SYSTEM STUDY Final Report
P. Gorton and M. Thomas Paris, France ESA Jun. 1987 287 p
(Contract ESTEC-6591/86-NL-JS)
(C04825.08/FR; ESA-CR(P)-2508; ETN-88-92553) Copyright Avail: NTIS HC A13/MF A01

The baseline concept of the POPSAT system was studied to make it more user-friendly. The baseline system was highly centralized and it appeared that it would be inflexible and remote from the user community and their needs. User requirements for various applications were assessed in detail to highlight the shortcomings of the baseline system. Improvements which affected the system architecture were combined into three candidate systems for further consideration. The candidate systems were studied, particularly memory requirements and channel capacity on the ranging links. Operational considerations and costs were also addressed. Until the financial constraints are made clear, it is not possible to make a final selection of the best candidate system. ESA

N88-23812*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENVIRONET: AN INTERACTIVE SPACE-ENVIRONMENT INFORMATION RESOURCE
Alfred L. Vampola, William N. Hall (Air Force Geophysics Lab., Hanscom AFB, Mass.), and Michael Lauriente 24 May 1988 13 p Prepared for Air Force Space Div., Los Angeles, Calif.
(Contract F04701-85-C-0086-P00019)
(NASA-TM-101137; TR-0088(3671-01)-1; NAS 1.15:101137; SD-TR-88-60) Avail: NTIS HC A03/MF A01 CSCL 22A

EnviroNET is an interactive menu-driven system set up as an information resource for experimenters, program managers, and design and test engineers involved in space missions. Its basic use is as a fundamental single source of data for the environment encountered by Shuttle and Space Station payloads, but it also has wider applicability in that it includes information on environments encountered by other satellites in both low altitude and high altitude (including geosynchronous) orbits. It incorporates both a text-retrieval mode and an interactive modeling code mode. The system is maintained on the ENVET MicroVAX computer at NASA/Goddard Space Flight Center. Its services are available at no cost to any user who has access to a terminal and modem. It is a tail-node on SPAN, and so it is accessible either directly or through BITNET, ARPANET, and GTE/TELENET via NPSS. Author

N88-23813# Bundesministerium fuer Forschung und Technologie, Bonn (West Germany).
ARGUMENTS FOR MANNED OR UNMANNED SPACECRAFT ACTIVITIES [ARGUMENTE FUER BEMANNTE UND UNBEMANNTE WELTRAUMAKTIVITAETEN]
19 Oct. 1987 20 p In GERMAN
(Rept-46/87; ETN-88-91949) Avail: NTIS HC A03/MF A01

Arguments for the critical assessment of technology needs to prepare manned spacecraft activities are presented. Studies in materials structure sciences and biosciences are especially required as for the FSLP and D1 missions. This evaluation suggests the possible substitution of man by automation in space experiments. Developments in this field are reviewed. ESA

N88-23814# European Space Agency, Paris (France).
PREPARING FOR THE NEW PROGRAMS. THE ESA TECHNOLOGICAL RESEARCH AND DEVELOPMENT PROGRAM 1988-1990
Norman Longdon, ed. Dec. 1987 209 p Original contains color illustrations
(ESA-SP-1095; TD(88)1; ETN-88-92557) Copyright Avail: NTIS HC A10/MF A01

The European Space Agency's R and D activities in Earth-space telematics; space communications infrastructure; global Earth monitoring; deep space and observatory facilities; microgravity utilization; manned systems and platforms; in-orbit operations and servicing; launcher and reentry technology; and common and genetic technology are outlined. ESA

N88-24376# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CIVIL MISSIONS APPLICATIONS STUDY
John Carlton Mankins and Jerry Olivieri *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 5-8 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

No abstracts in this category.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N88-23815 New South Wales Univ., Kensington (Australia). School of Electrical Engineering and Computer Science.
A LOW COST AUTOMATIC EARTH OBSERVATION SATELLITE TRACKING GROUND RECEIVING STATION M.S. Thesis Abstract Only
Robin R. Buckley Jul. 1987 254 p
Avail: Issuing Activity

An easy to build, reliable means of receiving regular satellite images of the Earth's surface and cloud cover is attractive to many users, particularly in emerging nations and in educational establishments interested in obtaining up to date data for remote sensing image analysis work. A low cost system able to receive signals from orbiting Earth observation satellites at S-band and VHF together with suitable program controlled tracking antennae was designed and built. The satellites of primary interest were the American NOAA series, although the Soviet Meteor satellites were also tracked. Several passes of both NOAA 7 (afternoon) and NOAA 8 (morning and evening) Advanced Very High Resolution Radiometer (AVHRR) transmissions were tracked successfully on S-band. In addition, numerous Automatic Picture Transmissions (APT) from NOAA and Meteor satellite passes were recorded. Some of the APT images produced from these recordings are presented. It became apparent that the effectiveness of the system build for the project could be considerably enhanced in three ways. Author

N88-24284# Hanford Engineering Development Lab., Richland, Wash.
CONCEPTUAL DESIGN OF THE SP-100 GES TEST SITE
W. C. Miller, J. L. Ethridge, P. J. Brackenbury, W. F. Carlson, P. A. Edwards, J. J. Irwin, E. J. Renkey, and E. J. Shen *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 121-124 (For primary document

see N88-24254 17-73)
(Contract DE-AC06-76FF-02170)
Avail: NTIS HC A22/MF A01

N88-24496# Westinghouse Hanford Co., Richland, Wash.
SP-100 GROUND ENGINEERING SYSTEMS TEST FACILITY CONTROL SYSTEMS
William F. Carlson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 601-603 (SEE N88-24374 17-73) 1988 (For primary document see N88-24374 17-73)
(Contract DE-AC06-87RL-10930)
Avail: NTIS HC A99/MF A01

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N88-23816# Centre National d'Etudes Spatiales, Toulouse (France). Dept. Integration Lancement.
ARIANE 4 PYROTECHNICS SYSTEM: DEFINITION OF THE CHAINS AND PYROTECHNIC DEVICES [SYSTEME VEHICLE ARIANE 4 SYSTEME PYROTECHNIQUE. DEFINITION DES CHAINES ET DES DISPOSITIFS PYROTECHNIQUES]
Jean-Pierre Bouloumie Paris, France ESA 18 Jan. 1988 240 p In FRENCH Original contains color illustrations
(CNES-88/CT/DRT/TVE/IL/25; ETN-88-92563) Avail: NTIS HC A11/MF A01

The Ariane 4 pyrotechnics systems and their components are described. The technical requirements and design rules applied during development of the devices are recalled. A catalog of the pyrotechnical devices used in Ariane 4 is presented. ESA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N88-23817*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REVIEW OF CONVECTIVELY COOLED STRUCTURES FOR HYPERSONIC FLIGHT
Charles P. Shore May 1986 70 p Presented at the SAE Aerospace Vehicle Technology Conference, Structural Technology Session, Arlington, Va., 12-14 May 1986
(NASA-TM-87740; NAS 1.15:87740) Avail: NTIS HC A04/MF A01 CSCL 22B

Resurgent interest in development of Aerospace Plane and Orient Express type vehicles promises to stretch structural technology for hypersonic flight vehicles to the uppermost limits. Significant portions of the structure may require active cooling of some type to survive hostile environments. Despite a lack of recent research activity for cooled structures, a significant body of unclassified knowledge exists concerning such structures. Contractual and in-house research conducted mainly by NASA's Langley Research Center during the 60's and 70's on vehicles very similar to the proposed Orient Express has provided a substantial data base for convectively cooled hypersonic flight structures. Specifically, results are presented for regeneratively cooled structural concepts which have a relatively high heat flux capability and use the hydrogen fuel directly as a coolant; and for structural concepts which use a secondary coolant loop to absorb incident heating and then transfer the absorbed heat to the liquid hydrogen fuel as it flows to the engines. Results are presented to indicate application regions in terms of heat flux capability for various concepts and benefits for each concept. Experience gained and costs are discussed in terms of heat flux capability for various concepts and benefits for each concept. Additionally, experience gained and cost involved with design, fabrication, and testing of full-scale convectively cooled structures are discussed. Author

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N88-23818# Royal Aircraft Establishment, Farnborough (England).
THE PREDICTION OF SATELLITE LIFETIMES
D. G. King-Hele and Doreen M. C. Walker May 1987 69 p
(RAE-TR-87030; RAE-SS-1; BR103730; ETN-88-92046)
Copyright Avail: NTIS HC A04/MF A01

Accurate prediction of the lifetimes of satellites decaying naturally under the action of air drag is one of the most difficult problems of orbital dynamics. Lifetime estimation is also a matter of practical importance when a satellite perceived as dangerous is about to decay. The time when the satellite finally plunges into the lower atmosphere is affected by at least eight identifiable types of variation in upper-atmosphere density, by odd zonal harmonics in the gravitational field, and by possible changes in the mode of rotation of the satellite. For use in the RAE Table of Satellites we have since 1958 made (and revised) lifetime estimates for all satellites, rockets and other major components (but not fragments). More than 10,000 such predictions have been made, nearly all being calculated from the current observed decay rate. This Report summarizes the methods used in the past and gives the results of new orbital theory developed to take better account of the effects of atmospheric oblateness and odd zonal harmonics in the geopotential. The Report also describes new approximate methods to allow for the effect of the solar-cycle and day-to-night variations in air density, and includes discussion of other sources of error. ESA

N88-23819# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
TRAVELLING WAVE CONCEPTS FOR THE MODELING AND CONTROL OF SPACE STRUCTURES Final Report, 1 Mar. 1986 - 31 Oct. 1987
A. H. VonFlotow and S. R. Hall 31 Jan. 1988 442 p
(Contract F49620-86-C-0039)
(AD-A191235; AFOSR-88-0278TR) Avail: NTIS HC A19/MF A01 CSCL 22A

This report summarizes 20 months of research into Travelling Wave Concepts for the Modelling and Control of Space Structures. A good portion of the research has focused upon the development

of techniques for the modelling of structural response in terms of disturbance propagation. Such models are of interest for several reasons: (1) Understanding the mechanisms that govern the propagation of disturbances through an elastic structure is useful for building intuition, for structural design and for design of active control, (2) Disturbance propagation models have the potential for providing high-fidelity analysis capabilities in response regimes where other techniques are inapplicable. Of considerable interest to the researchers at MIT is the response of elastic spacecraft to disturbances with significant spectral content at frequencies including many (even hundreds) of the spacecraft natural modes of structural vibration; and (3) Elastic disturbance propagation is a classic area of research in applied mechanics, having application in acoustics, seismology, microwave electronics, transducer design, biological fluid mechanics, design of mechanisms and machines, and many other areas. GRA

N88-23820# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
COLUMBUS FEASIBILITY STUDIES, EXECUTIVE SUMMARY
1988 96 p Sponsored by the Bundesministerium fuer Forschung und Technologie, Bonn, Fed. Republic of Germany and the PSN/MSRT Prepared in cooperation with Aeritalia S.p.A., Turin, Italy and Dornier Werke GmbH, Friedrichshafen, Fed. Republic of Germany
(ETN-88-92334) Avail: NTIS HC A05/MF A01

The Columbus Space Station elements, operating scenario, payload requirements, system design, and development are summarized. Columbus consists of a resource module, pressurized module, payload carrier, and servicing vehicle for work in material and fluid sciences, life sciences, space sciences, and Earth observation. The implementation of respective infrastructure elements is based on experience gained on the space systems produced (e.g., Spacelab) or defined (e.g., EURECA) in Europe, and is tailored to stepwise build-up from initial to ultimate capabilities offered to ESA for European-wide conduct. Cost and schedule assessments, together with technical and programmatic definitions, confirm that the Columbus program is well within realistic European potentials. ESA

N88-23821# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Structures and Mechanisms Div.
STRUCTURAL ACOUSTICS DESIGN MANUAL
D. C. G. Eaton Oct. 1987 237 p
(ESA-PSS-03-1201-Issue-1; ISSN-0379-4059; ETN-88-92548)
Copyright Avail: NTIS HC A11/MF A01

During research on noise-related satellite structural vibration problems, a large quantity of experimental information was obtained, and methods of predicting the relevant vibration response were developed, including the computer program GENSTEP2 (GENeral STatistical Energy Program), based on statistical energy analysis concepts, which can be used to predict the response of structural configurations, including the effects of acoustic cavities. The means of predicting the response of equipment and structures to high-frequency vibration environments, to be used from the preliminary design stage onwards, are outlined. Many of the methods rely on empirical and physical observations as well as mathematical models of the environment and the structural response. The prediction techniques must therefore be used with care and with an understanding of their purpose and limitations. ESA

N88-23822# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Structures and Mechanisms Div.
INSERT DESIGN HANDBOOK
Jun. 1987 482 p
(ESA-PSS-03-1202-Issue-1; ISSN-0379-4059; ETN-88-92549)
Copyright Avail: NTIS HC A21/MF A01

All the information relevant to the design, manufacturing, and verification of insert systems (limited to a restricted number of standard dimensions) for ESA programs is presented. ESA

N88-23823# Science Applications International Corp., McLean, Va.
SOVIET SPACECRAFT ENGINEERING RESEARCH
J. F. Garibotti, M. Aswani, E. F. Crawley, W. C. Kessler, K. Soosaar, J. D. Turner, and W. P. Witt Oct. 1987 164 p
(FASAC-TAR-3090) Avail: NTIS HC A08/MF A01

The Soviet published literature in spacecraft engineering pertaining to future space systems, including those utilizing large structures is assessed. Topical areas emphasized include advanced structural concepts and associated construction approaches, spacecraft materials, precision pointing and rapid retargeting, geometrically precise structures in the presence of static and dynamic disturbances, and spacecraft vulnerability as it relates to these aspects of spacecraft engineering. The assessment indicates that the Soviets have significant strengths and specialties in spacecraft engineering. The Soviet space station appears to be the principal Soviet large system of the near future, and this will expand and evolve in size and capability. Radio astronomy missions are also genuine drivers for large space structure technology, including space construction capability. In the structural materials area, the Soviets can be expected to develop high quality, structurally efficient fiber-reinforced metal-matrix composites, which will be used to improve the performance and possibly the survivability of future Soviet spacecraft. The technology of control-structure interaction, important in the design of large space-based lasers, is receiving considerably more support, based on the published literature, in the United States than in the Soviet Union. Author

N88-23824*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON-ORBIT TECHNOLOGY EXPERIMENT FACILITY DEFINITION
Richard A. Russell, Robert W. Buchan, and Richard M. Gates (Boeing Aerospace Co., Seattle, Wash.) May 1988 145 p
(NASA-TM-100614; NAS 1.15:100614) Avail: NTIS HC A07/MF A01 CSCL 22B

A study was conducted to identify on-orbit integrated facility needs to support in-space technology experiments on the Space Station and associated free flyers. In particular, the first task was to examine the proposed technology development missions (TDMX's) from the model mission set and other proposed experimental facilities, both individually and by theme, to determine how and if the experiments might be combined, what equipment might be shared, what equipment might be used as generic equipment for continued experimentation, and what experiments will conflict with the conduct of other experiments or Space Station operations. Then using these results, to determine on-orbit facility needs to optimize the implementation of technology payloads. Finally, to develop one or more scenarios, design concepts, and outfitting requirements for implementation of onboard technology experiments. Author

N88-23825*# Maryland Univ., College Park. Dept. of Aerospace Engineering.
ENGINEERING PLANETARY LASERS FOR INTERSTELLAR COMMUNICATION M.S. Thesis
Brent Sherwood May 1988 623 p
(Grant NGT-21-002-823)
(NASA-CR-180780; NAS 1.26:180780; UMAERO-88-5) Copyright Avail: NTIS HC A99/MF A01 CSCL 22B

Transmitting large amounts of data efficiently among neighboring stars will vitally support any eventual contact with extrasolar intelligence, whether alien or human. Laser carriers are particularly suitable for high-quality, targeted links. Space laser transmitter systems designed by this work, based on both demonstrated and imminent advanced space technology, could achieve reliable data transfer rates as high as 1 kb/s to matched receivers as far away as 25 pc, a distance including over 700 approximately solar-type stars. The centerpiece of this demonstration study is a fleet of automated spacecraft incorporating adaptive neural-net optical processing active structures, nuclear electric power plants, annular momentum control

devices, and ion propulsion. Together the craft sustain, condition, modulate, and direct to stellar targets an infrared laser beam extracted from the natural mesospheric, solar-pumped, stimulated CO2 emission recently discovered at Venus. For a culture already supported by mature interplanetary industry, the cost of building planetary or high-power space laser systems for interstellar communication would be marginal, making such projects relevant for the next human century. Links using high-power lasers might support data transfer rates as high as optical frequencies could ever allow. A nanotechnological society such as we might become would inevitably use 10 to the 20th power b/yr transmission to promote its own evolutionary expansion out of the galaxy.

Author

N88-23826*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LDR STRUCTURAL EXPERIMENT DEFINITION
Richard A. Russell and Richard M. Gates (Boeing Aerospace Co., Seattle, Wash.) Jun. 1988 51 p
(NASA-TM-100618; NAS 1.15:100618) Avail: NTIS HC A04/MF A01 CSCL 22B

A study was performed to develop the definition of a structural flight experiment for a large precision segmented reflector that would utilize the Space Station. The objective of the study was to use the Large Deployable Reflector (LDR) baseline configuration for focusing on experiment definition activity which would identify the Space Station accommodation requirements and interface constraints. Results of the study defined three Space Station based experiments to demonstrate the technologies needed for an LDR type structure. The basic experiment configurations are the same as the JPL baseline except that the primary mirror truss is 10 meters in diameter instead of 20. The primary objectives of the first experiment are to construct the primary mirror support truss and to determine its structural and thermal characteristics. Addition of the optical bench, thermal shield and primary mirror segments and alignment of the optical components occur on the second experiment. The structure will then be moved to the payload pointing system for pointing, optical control and scientific optical measurement for the third experiment. Author

N88-23827* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LOCKING HINGE Patent
Clarence J. Wesselski, inventor (to NASA) 12 Apr. 1988 9 p Filed 29 Oct. 1986 Supersedes N87-18595 (25 - 11, p 1446)
(NASA-Case-MSC-21056-1; US-Patent-4,736,490; US-Patent-Appl-SN-934397; US-Patent-Class-16-292; US-Patent-Class-16-297; US-Patent-Class-16-326; US-Patent-Class-16-332; US-Patent-Class-16-345; US-Patent-Class-16-347; US-Patent-Class-16-349) Avail: US Patent and Trademark Office CSCL 22B

The space station configuration currently studied utilizes structures which require struts to be hinged in the middle in the stowed mode and locked into place in the deployed mode. Since there are hundreds of hinges involved, it is necessary that they have simple, positive locking features with a minimum of joint looseness or slack. This invention comprises two similar housings hinged together with a spring loaded locking member which assists in making as well as breaking the lock. This invention comprises a bracket hinge and bracket members with a spring biased and movable locking member. The locking or latch member has ear parts received in locking openings where wedging surfaces on the ear parts cooperate with complimentary surfaces on the bracket members for bringing the bracket members into a tight end-to-end alignment when the bracket members are in an extended position. When the locking member is moved to an unlocking position, pivoting of the hinge about a pivot pin automatically places the locking member to retain the locking member in an unlocked position. In pivoting the hinge from an extended position to a folded position, longitudinal spring members are placed under tension over annular rollers so that the spring tension in a folded position assists in return of the hinge from a folded to an extended position. Novelty lies in the creation of a locking hinge which allows compact storage and easy assembly of structural members having a minimal number of parts.

Official Gazette of the U.S. Patent and Trademark Office

N88-23828* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPACE SPIDER CRANE Patent
Ian O. Macconochie, inventor (to NASA), Martin M. Mikulas, Jr., inventor (to NASA), Jack E. Pennington, inventor (to NASA), Rebecca L. Kinkead, inventor (to NASA), and Charles F. Bryan, Jr., inventor (to NASA) 19 Apr. 1988 13 p Filed 30 Sep. 1986 Supersedes N87-15259 (25 - 07, p 874)
(NASA-Case-LAR-13411-1-SB; US-Patent-4,738,583; US-Patent-Appl-SN-913432; US-Patent-Class-414-735; US-Patent-Class-414-750; US-Patent-Class-901-1; US-Patent-Class-901-33; US-Patent-Class-180-8.6) Avail: US Patent and Trademark Office CSCL 22B

A space spider crane for the movement, placement, and or assembly of various components on or in the vicinity of a space structure is described. As permanent space structures are utilized by the space program, a means will be required to transport cargo and perform various repair tasks. A space spider crane comprising a small central body with attached manipulators and legs fulfills this requirement. The manipulators may be equipped with constant pressure gripping end effectors or tools to accomplish various repair tasks. The legs are also equipped with constant pressure gripping end effectors to grip the space structure. Control of the space spider crane may be achieved either by computer software or a remotely situated human operator, who maintains visual contact via television cameras mounted on the space spider crane. One possible walking program consists of a parallel motion walking program whereby the small central body alternatively leans forward and backward relative to end effectors.

Official Gazette of the U.S. Patent and Trademark Office

N88-24004# Meteorological Satellite Center, Tokyo (Japan).
PROSPECTS OF SATELLITE WIND SENSING SYSTEMS IN THE YEARS 1995-2000
Tadaaki Hamada *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 1-8 Presented at the Workshop on Space Systems Possibilities for Global Energy and Water Cycle Experiment, Columbia, Md., 19-23 Jan. 1987 (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

N88-24149*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SPACE STATION PROXIMITY OPERATIONS AND WINDOW DESIGN
Richard F. Haines *In its* Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 1-18 (For primary document see N88-24148 17-51)
Avail: NTIS HC A07/MF A01 CSCL 22B

N88-24154*# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
FAULT DIAGNOSIS IN ORBITAL REFUELING OPERATIONS
Guy A. Boy *In* NASA, Ames Research Center, Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 89-112 (For primary document see N88-24148 17-51)
Avail: NTIS HC A07/MF A01 CSCL 22B

N88-24282# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
FABRICATION OF LITHIUM HYDRIDE SHIELDS FOR SPACE NUCLEAR POWER SYSTEMS
Richard L. Gay *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 115-118 (For primary document see N88-24254 17-73)
(Contract AT(11-1)-GEN-8)
Avail: NTIS HC A22/MF A01

N88-24315*# General Electric Co., Philadelphia, Pa. Space Systems Div.
RADIATION HARDENING DESIGN OF NUCLEAR POWERED SPACECRAFT
R. E. Schmidt *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 261-262 (For primary document see N88-24254 17-73)
(Contracts JPL-956473; DE-AC03-86SF-16006)
Avail: NTIS HC A22/MF A01 CSCL 18K

N88-24332# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
A THERMAL EQUILIBRIUM MODEL FOR MULTI-MEGAWATT SPACE PLATFORMS
Mark David DeHart *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 335-338 Sponsored by DOE, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24333# Los Alamos National Lab., N. Mex.
A REVIEW OF IMPACT DESIGN CRITERIA FOR SPACE POWER HEAT REJECTION SYSTEMS
Lynn B. Lundberg *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 339-342 Sponsored by DOE, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24380# Los Alamos National Lab., N. Mex.
NUCLEAR-POWERED SPACE DEBRIS SWEEPER
John D. Metzger, Steven D. Howe, Rene J. LeClaire, Jr., and Karen C. Burgin *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 23-27 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24387*# New Mexico Univ., Albuquerque. Technology Application Center.
REVIEW OF POWER REQUIREMENTS FOR SATELLITE REMOTE SENSING SYSTEMS
Stanley A. Morain *In its* Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 55-63 (For primary document see N88-24374 17-73)
(Contract NASw-4191)
Avail: NTIS HC A99/MF A01 CSCL 22B

N88-24392# Los Alamos National Lab., N. Mex.
INDIVIDUAL SATELLITE POWER REQUIREMENTS CALCULATED FROM SPECIFIED CONSTELLATION PERFORMANCE
Duane R. Marr, Russell B. Kidman, and W. Greg Lacey *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 85-88 Sponsored by DOE, Washington, D.C. and DOD, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24393# California Univ., Los Angeles. Dept. of Mechanical Aerospace and Nuclear Engineering.
DEVELOPMENT OF A LIGHTWEIGHT STRUCTURE WITH LOAD BEARING CAPABILITY AND HIGH THERMAL CONDUCTANCE
Vu X. Tung and Vijay K. Dhir *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 89-92 Sponsored by Innovative Nuclear Space Power Inst. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24416# Sandia National Labs., Albuquerque, N. Mex. Advanced Nuclear Power Systems Safety Div.
THE EFFECT OF MAXIMUM ALLOWABLE PAYLOAD TEMPERATURE ON THE MASS OF A MULTIMEGAWATT SPACE BASED PLATFORM
Dean Dobranich *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 205-208 (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01

N88-24417# Aerospace Corp., Albuquerque, N. Mex.
SPACE VEHICLE/NUCLEAR REACTOR THERMAL RADIATION INTEGRATION ISSUES
Richard D. Jimenez and Arthur W. Joslin *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 209-214 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24426# Brookhaven National Lab., Upton, N. Y.
ANALYSIS OF A NUCLEAR ORBITAL TRANSFER VEHICLE REENTRY ACCIDENT
James R. Powell, Hans Ludewig, Otto W. Lazareth, and Frederick L. Horn *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 257-261 Sponsored by AFRPL, Edwards AFB, Calif. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N88-23829*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A CYCLIC GROUND TEST OF AN ION AUXILIARY PROPULSION SYSTEM: DESCRIPTION AND OPERATIONAL CONSIDERATIONS
Jerri S. Ling and Edward H. Kramer Jun. 1988 54 p
(NASA-TM-100870; E-3251; NAS 1.15:100870) Avail: NTIS HC A04/MF A01 CSCL 21H

The Ion Auxiliary Propulsion System (IAPS) experiment is designed for launch on an Air Force Space Test Program satellite (NASA-TM-78859; AIAA Paper No. 78-647). The primary objective of the experiment is to flight qualify the 8 cm mercury ion thruster system for stationkeeping applications. Secondary objectives are measuring the interactions between operating ion thruster systems and host spacecraft, and confirming the design performance of the thruster systems. Two complete 8 cm mercury ion thruster subsystems will be flown. One of these will be operated for 2557 on and off cycles and 7057 hours at full thrust. Tests are currently under way in support of the IAPS flight experiment. In this test an IAPS thruster is being operated through a series of startup/run/shut-down cycles which simulate thruster operation

during the planned flight experiment. A test facility description and operational considerations of this testing using an engineering model 8 cm thruster (S/N 905) is the subject of this paper. Final results will be published at a later date when the ground test has been concluded. Author

N88-23830*# Rocket Research Corp., Redmond, Wash.
ARCJET THRUSTER RESEARCH AND TECHNOLOGY, PHASE 1 Final Report
Steven C. Knowles 30 Sep. 1987 145 p
(Contract NAS3-24631)
(NASA-CR-182107; NAS 1.26:182107; Rept-87-R-1175) Avail: NTIS HC A07/MF A01 CSCL 21H

The objectives of Phase 1 were to evaluate analytically and experimentally the operation, performance, and lifetime of arcjet thrusters operating between 0.5 and 3.0 kW with catalytically decomposed hydrazine (N2H4) and to begin development of the requisite power control unit (PCU) technology. Fundamental analyses were performed of the arcjet nozzle, the gas kinetic reaction effects, the thermal environment, and the arc stabilizing vortex. The VNAP2 flow code was used to analyze arcjet nozzle performance with non-uniform entrance profiles. Viscous losses become dominant beyond expansion ratios of 50:1 because of the low Reynolds numbers. A survey of vortex phenomena and analysis techniques identified viscous dissipation and vortex breakdown as two flow instabilities that could affect arcjet operation. The gas kinetics code CREK1D was used to study the gas kinetics of high temperature N2H4 decomposition products. The arc/gas energy transfer is a non-equilibrium process because of the reaction rate constants and the short gas residence times. A thermal analysis code was used to guide design work and to provide a means to back out power losses at the anode fall based on test thermocouple data. The low flow rate and large thermal masses made optimization of a regenerative heating scheme unnecessary. Author

N88-23831*# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
SSME TECHNOLOGY TEST BED FAST SHUTDOWN ASSESSMENT Final Report
A. Liebman and J. O. Vilja 12 May 1988 41 p
(Contract NAS8-40000)
(NASA-CR-179354; NAS 1.26:179354; RSS-8788) Avail: NTIS HC A03/MF A01 CSCL 21H

The fastest practical shutdown sequence for the Technology Test Bed Engine is developed. A sequence is defined and key issues addressed. The conclusion of the study is that a fastest shutdown sequence within the existing SSME design capability is practical and can cut oxidizer consumption by 50 percent. However, the revised sequence would not have prevented any of the prior experienced SSME incidents and would introduce development risk to the program. Author

N88-24268# Commissariat a l'Energie Atomique, Gif-sur-Yvette (France). Centre d'Etudes Nucleaires.
STATUS OF CEA DESIGN AND SIMULATION STUDIES OF A 200 KWe TURBOELECTRIC SPACE POWER SYSTEM
F. Carre, E. Proust, F. Gervaise, J. P. Schwartz, Z. Tilliette, and B. Vrillon *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 55-60 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24270# Los Alamos National Lab., N. Mex.
HISTORY OF SOME DIRECT NUCLEAR PROPULSION DEVELOPMENTS SINCE 1946
Richard J. Bohl, Jay E. Boudreau, and William L. Kirk *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 65-68 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24271# Air Force Rocket Propulsion Lab., Edwards AFB, Calif. Applications Analysis Branch.
DIRECT NUCLEAR PROPULSION FOR EARTH-TO-ORBIT VEHICLES
David R. Perkins *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 69-72 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24272# Brookhaven National Lab., Upton, N. Y. Dept. of Nuclear Energy.
NUCLEAR PROPULSION SYSTEMS FOR ORBIT TRANSFER BASED ON THE PARTICLE BED REACTOR
J. R. Powell, H. Ludewig, F. L. Horn, K. Araj, R. Benenati, O. Lazareth, G. Slovik, M. Solon, W. Tappe, and J. Belisle (Grumman Aerospace Corp., Bethpage, N.Y.) et al. *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 73-76 Previously announced as N87-28405 Sponsored by AFRPL, Edwards AFB, Calif. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24273*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
INTERPLANETARY PROPULSION USING INERTIAL FUSION
Charles D. Orth, Nate Hoffman, Kathy Murray, Gail Klein (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), and Franklin Chang Diaz *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 77-80 Previously announced as N88-12540 (For primary document see N88-24254 17-73)
(Contract W-7405-eng-38)
Avail: NTIS HC A22/MF A01 CSCL 21H

N88-24274*# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
A FUSION BASED PLASMA PROPULSION SYSTEM
J. A. George, B. Anderson, D. Bryant, C. Creese, V. Djordjevic, and K. L. Peddicord *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 81-84 Sponsored by NASA, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 21H

N88-24275# Brookhaven National Lab., Upton, N. Y.
ULTRA HIGH TEMPERATURE DIRECT PROPULSION
K. J. Araj, G. Slovik, J. R. Powell, and H. Ludewig *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 85-88 Previously announced as N87-27718 Sponsored by AFRPL, Edwards AFB, Calif. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24276# Science Applications International Corp., Albuquerque, N. Mex.
SAFETY CONSTRAINTS AND CONSIDERATIONS IN THE DEVELOPMENT OF NUCLEAR POWERED PROPULSION
David Buden *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 89-91 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24292# Cincinnati Univ., Ohio. Dept. of Physics.
BIFOLD: A DUAL-MODE NUCLEAR SPACE POWER SYSTEM
Warren Fenton Stubbins *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 157-160 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24294*# Princeton Univ., N. J. Electric Propulsion Lab.
MEGAWATT LEVEL ELECTRIC PROPULSION PERSPECTIVES
Robert G. Jahn and Arnold J. Kelly *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 167-171 (For primary document see

N88-24254 17-73)
(Contracts JPL-954997; F04611-85-C-004)
Avail: NTIS HC A22/MF A01 CSCL 21H

N88-24295*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH POWER ION THRUSTER PERFORMANCE
Vincent K. Rawlin and Michael J. Patterson *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 173-176 Previously announced as N88-12542 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 21H

N88-24296*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRIC PROPULSION OPTIONS FOR THE SP-100 REFERENCE MISSION
Terry L. Hardy, Vincent K. Rawlin, and Michael J. Patterson *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 177-180 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 21H

N88-24297*# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
A CRITIQUE OF NERVA BASED NUCLEAR REACTOR DESIGN AND PERFORMANCE FOR MMW SPACE PROPULSION APPLICATIONS
R. R. Holmar. *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 181-183 Sponsored by NASA, Washington, D.C. and AEC, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 21H

N88-24298# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
NUCLEAR ELECTRIC PROPULSION SYSTEM: NUCLEAR PLANT AND THERMOMECHANICAL CONVERSION SYSTEM
Dion J. Sunderland and K. L. Peddicord *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 185-189 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24351*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF CLOSED CYCLE MEGAWATT CLASS SPACE POWER SYSTEMS WITH NUCLEAR REACTOR HEAT SOURCES
A. J. Juhasz and B. I. Jones *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 423-426 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 21H

N88-24369# TRW Space Technology Labs., Redondo Beach, Calif. Space and Technology Group.
A GENERALIZED METHOD FOR OPTIMIZING THE MASS OF SPACE POWER SYSTEMS
J. K. Garner, T. J. Fitzgerald, and B. B. Glasgow *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 501-504 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24379# Idaho National Engineering Lab., Idaho Falls.
COMPARISON OF A DIRECT THRUST NUCLEAR ENGINE, NUCLEAR ELECTRIC ENGINE AND A CHEMICAL ENGINE FOR FUTURE SPACE MISSIONS
Jack H. Ramsthaler and Tal K. Sulmeisters (Martin Marietta Corp., Englewood, Colo.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 19-22 (For primary document see N88-24374 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A99/MF A01

N88-24388*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTROMAGNETIC POWERED VEHICLES (EMPV) FOR MARS EXPLORATION
Jose L. Christian, Jr. and Ira T. Myers *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 67-70 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 21H

N88-24441# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
NUCLEAR PROPULSION: PAST, PRESENT AND FUTURE
V. E. Haloulakos and C. B. Boehmer *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 329-332 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24442# Idaho National Engineering Lab., Idaho Falls.
GAS CORE REACTORS FOR DIRECT NUCLEAR PROPULSION
Bruce G. Schnitzler *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 333-336 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24443*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF HIGH POWER ELECTRIC PROPULSION TECHNOLOGY
David C. Byers and James R. Stone *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 337-340 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 21F

N88-24445# Air Force Astronautics Lab., Edwards AFB, Calif. Liquid Rocket Div.
SOLAR THERMAL PROPULSION FOR ORBIT TRANSFER VEHICLES
Charles R. Ford *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 345-348 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24482# Idaho National Engineering Lab., Idaho Falls.
TEST PLAN AND FACILITIES FOR QUALIFYING NUCLEAR ROCKET FUEL ELEMENTS
Zoel R. Martinson and Jack H. Ramsthaler *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 529-533 Sponsored in part by Air Force Astronautics Lab., Edwards AFB, Calif. (For primary document see N88-24374 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A99/MF A01

23 CHEMISTRY AND MATERIALS (GENERAL)

N88-23832 New South Wales Univ., Kensington (Australia). Dept. of Food Science and Technology.
IDENTIFICATION OF HYDROXYPROPYL STARCH HYDROLYSATE COMPONENTS Abstract Only. Ph.D. Thesis
Haryadi Aug. 1987 230 p
Avail: Issuing Activity

Hydroxypropyl starch was prepared from pregelatinized wheat starch and characterized. The starch was hydrolyzed using

sulphuric acid. After separation by HPLC, six non-glucose components were identified. The results were confirmed by comparison with hydroxypropyl derivatives of glucose. Fractions of starch hydrolysate isolated by HPLC were acetylated and subjected to structural elucidation using H-1-NMR spectrometry. Six components were identified. Similar results were obtained from C-13-NMR studies. Quantitative HPLC analysis of acid hydrolysates of low MS hydroxypropyl wheat and maize starches indicated that over 82 percent of the hydroxypropyl groups were attached to C2 of the glucose moiety and over 3 percent to C6 in each. The values of molar substitution deduced from the chromatograms were similar to those determined spectrophotometrically. Hydrolysis of hydroxypropyl starch by porcine pancreatic o-amylase and by glucoamylase was studied using HPLC of fractionated digests. The absence of modified monomer in digests, and hydroxypropyl glucitol in acid hydrolysates of borohydride reduced digests indicated the failure of both enzymes to hydrolyse the alpha-(1,4) linkages at C1 of the substituted anhydroglucose residues. Author

N88-23833 New South Wales Univ., Kensington (Australia).
SACCHARIFICATION OF CELLULOSE BY COMBINED FUNGAL AND BACTERIAL PREPARATIONS Abstract Only. Ph.D. Thesis
Baharuddin Abdul Ghani Sep. 1987 296 p
Avail: Issuing Activity

A combined saccharification system was developed whereby the merits of various bacterial beta-glucosidase preparations could be assessed. This consisted of allowing low levels of Trichoderma reesei to act on cellulosic substrates. A recombinant plasmid, pND71, which carried an insert that encoded for beta-glucosidase, was mobilized by conjugation into a range of non-cellulolytic Pseudomonas wild type strains. The transconjugant strain 17498(pND71), which had the highest beta-glucosidase activity, was selected and its level of beta-glucosidase increased by improving the growth conditions. When used as the bacterial component in the combined saccharification system, strain 17498(pND71) was more effective than its parent or either of the other wild-type strains tested in acting synergistically with Trichoderma reesei to solubilize more carbohydrate and produce more glucose. The effect was greater with the more crystalline substrates tested than with amorphous alkali-treated bagasse. The beta-glucosidase activity of 17498(pND71) was shown to be cell associated and active towards both pNPG and cellobiose. The investigation demonstrated the efficacy of recombinant DNA technology to produce bacterial strains with improved beta-glucosidase activity and hence ability to contribute to the saccharification of cellulose. Author

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials*.

N88-23834# Centre d'Essais Aeronautique Toulouse (France). Section d'Etudes des Materiaux et Technologies Cellule.
INVESTIGATION OF THE LONG TERM EFFECTS OF AGING ON CARBON EPOXY COMPOSITES EXPOSED NATURALLY TO THE WEATHER UNDER CYCLIC LOADS. (RESULTS OF SAMPLING AFTER 2.5 YEARS). TEST REPORT M1-641300 [ETUDE DES EFFETS A LONG TERME DU VIEILLISSEMENT DES COMPOSITES CARBONE-EPOXY PAR EXPOSITION NATURELLE AUX INTEMPERIES SOUS CHARGES CYCLEES (RESULTATS DU PRELEVEMENT A 2 ANS ET DEMI). PROCES VERBAL M1-641300]
10 Jul. 1987 47 p In FRENCH
(CEAT-39/M/79-C-M1-641300; ETN-88-92161) Avail: NTIS HC A03/MF A01

Long term fatigue and natural weathering tests on carbon epoxy composites Fibredux 914 C and T300/N5208 are discussed. Results of sampling after 2.5 yr show no reduction in mechanical properties, although noticeable erosion of the matrix at the surface of samples is reported. Moisture absorption is as expected for T300/N5208, but much less for 914 C. This result could be a false impression due to moisture trapping by the material. ESA

N88-23835 Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique des Materiaux.
INFLUENCE OF FIBER REINFORCEMENT ON THE VITREOUS TRANSITION TEMPERATURE OF M 10 MATRIX COMPOSITES [INFLUENCE DU RENFORT FIBREUX SUR LA TEMPERATURE DE TRANSITION VITREUSE DES COMPOSITES A MATRICE M 10]
M. C. Merienne and J. P. Favre Jan. 1987 23 p In FRENCH
(Contract DRET-85-34-001)
(ONERA-RT-44/7086-M; ETN-88-92166) Avail: ONERA, 29 Avenue de la Division Leclerc, 92320 Chatillon, France

The vitreous transition temperature of M 10 resin with glass fibers and Kevlar (Tm) was compared to the Tg of the resin alone. Results show a lowering of the temperature of the maximum absorption compared to the resin alone and an effect of fiber orientation on Tm (Tm tends to Tg as strain modulus increases). This latter effect is of mechanical origin, the energy dissipated varying inversely to the modulus of elasticity. The lowering of the vitreous transition temperature results from the existence, on contact with the fibers, of a zone of the matrix not having the characteristics of the mass resin. ESA

N88-23836# Institut National Polytechnique, Grenoble (France). Genie Physique et Mecanique des Materiaux.
STRUCTURE AND MECHANICAL PROPERTIES OF METAL MATRIX COMPOSITES MADE USING SEMI-SOLID PROCESSES: THE CASE OF THE SYSTEM Al-Si/SiC [STRUCTURES ET PROPRIETES MECANIQUES DE MATERIAUX COMPOSITES A MATRICE METALLIQUES ELABORES PAR VOIE SEMI-SOLIDE. CAS DU SYSTEME AL-SI/SIC]
C. Milliere, M. Suery, and S. A. Bayoumi Sep. 1987 62 p Partly in ENGLISH and FRENCH
(Contract DRET-86-1367)
(ETN-88-92299) Avail: NTIS HC A04/MF A01

Composites made with Al-7 Wt percent Si alloys and discontinuous Nicalon SiC-fibers were prepared by compocasting followed by squeeze casting. This technique gives macroscopically homogeneous materials with some segregation of the fibers in the eutectic phase especially for the lowest volume fractions. The SiC fibers appreciably improve wear resistance, hardness, and compressive strength of the matrix, in the as-cast and heat treated conditions. An analysis of the compressive test results based on the mixture rule modified to apply to discontinuous randomly oriented fiber composites is given. It is shown that agreement between predictions and experimental results can only be obtained by considering the increase of the strength of the matrix due to the presence of the fibers. This increase is discussed in terms of structural changes and residual stresses created during cooling due to the difference in the coefficients of thermal expansion of the components. ESA

N88-23837# Royal Aircraft Establishment, Farnborough (England).
GARTEUR TP-037: IMPACT DAMAGE TOLERANCE OF CARBON FIBER AND HYBRID LAMINATES
G. Dorey, P. Sigety, K. Stellbrink, and W. G. J. tHart (National Aerospace Lab., Emmeloord, Netherlands) 1987 68 p
(RAE-TR-87057; RAE-MAT/STR-206; BR104949; ETN-88-92509)
Copyright Avail: NTIS HC A04/MF A01

It is confirmed that impact damage in carbon fiber reinforced composite laminates can reduce the static strengths and low cycle fatigue strengths significantly, especially the compressive strength. However, subsequent fatigue loading produces flat S-N curves and high cycle fatigue strengths are similar to those for undamaged laminates. Improvements can be made to the impact performance by optimizing laminates lay-ups and by the use of surface plies of carbon or glass fiber fabrics. More significant improvements in

the residual static strengths should come from improved materials properties, such as fiber, matrix, and interface properties, and from improved structural design. This may result in increased fatigue sensitivity. There is a need for quantitative techniques to predict the formation of the damage and the residual strengths. ESA

N88-23838*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STRAIN INTENSITY FACTOR APPROACH FOR PREDICTING THE STRENGTH OF CONTINUOUSLY REINFORCED METAL MATRIX COMPOSITES
C. C. Poe, Jr. May 1988 38 p
(NASA-TM-100617; NAS 1.15:100617) Avail: NTIS HC A03/MF A01 CSCL 11D

A method was previously developed to predict the fracture toughness (stress intensity factor at failure) of composites in terms of the elastic constants and the tensile failing strain of the fibers. The method was applied to boron/aluminum composites made with various proportions of 0 to + or - 45 deg plies. Predicted values of fracture toughness were in gross error because widespread yielding of the aluminum matrix made the compliance very nonlinear. An alternate method was developed to predict the strain intensity factor at failure rather than the stress intensity factor because the singular strain field was not affected by yielding as much as the stress field. Strengths of specimens containing crack-like slits were calculated from predicted failing strains using uniaxial stress-strain curves. Predicted strengths were in good agreement with experimental values, even for the very nonlinear laminates that contained only + or - 45 deg plies. This approach should be valid for other metal matrix composites that have continuous fibers. Author

N88-23839*# Lockheed-California Co., Burbank.
FUEL CONTAINMENT, LIGHTNING PROTECTION AND DAMAGE TOLERANCE IN LARGE COMPOSITE PRIMARY AIRCRAFT STRUCTURES Contractor Report, Feb. 1983 - Feb. 1985
Charles F. Griffin and Arthur M. James Washington NASA May 1985 38 p
(Contract NAS1-16856)
(NASA-CR-3875; NAS 1.26:3875; REPT-76-20) Avail: NTIS HC A03/MF A01 CSCL 11D

The damage-tolerance characteristics of high strain-to-failure graphite fibers and toughened resins were evaluated. Test results show that conventional fuel tank sealing techniques are applicable to composite structures. Techniques were developed to prevent fuel leaks due to low-energy impact damage. For wing panels subjected to swept stroke lightning strikes, a surface protection of graphite/aluminum wire fabric and a fastener treatment proved effective in eliminating internal sparking and reducing structural damage. The technology features developed were incorporated and demonstrated in a test panel designed to meet the strength, stiffness, and damage tolerance requirements of a large commercial transport aircraft. The panel test results exceeded design requirements for all test conditions. Wing surfaces constructed with composites offer large weight savings if design allowable strains for compression can be increased from current levels. Author

N88-23840*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LOCAL BUCKLING AND CRIPPLING OF COMPOSITE STIFFENER SECTIONS Interim Report
David L. Bonanni, Eric R. Johnson (Virginia Polytechnic Inst. and State Univ., Blacksburg.), and James H. Starnes, Jr. Jun. 1988 186 p
(Grants NAG1-343; NAG1-537)
(NASA-TM-101133; NAS 1.15:101133; CCMS-88-08; VPI-E-88-15; IR-71) Avail: NTIS HC A09/MF A01 CSCL 11D

Local buckling, postbuckling, and crippling (failure) of channel, zee, and I- and J-section stiffeners made of AS4/3502 graphite-epoxy unidirectional tape are studied by experiment and analysis. Thirty-six stiffener specimens were tested statically to failure in axial compression as intermediate length columns. Web width is 1.25 inches for all specimens, and the flange width-to-thickness ratio ranges from 7 to 28 for the specimens tested. The radius of the stiffener corners is either 0.125 or 0.250 inches. A sixteen-ply orthotropic layup, an eight-ply quasi-isotropic layup, and a sixteen-ply quasi-isotropic layup are examined. Geometrically nonlinear analyses of five specimens were performed with the STAGS finite element code. Analytical results are compared to experimental data. Inplane stresses from STAGS are used to conduct a plane stress failure analysis of these specimens. Also, the development of interlaminar stress equations from equilibrium for classical laminated plate theory is presented. An algorithm to compute high order displacement derivatives required by these equations based on the Discrete Fourier Transform (DFT) is discussed. Author

N88-23888*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CERAMIC MATRIX COMPOSITES
James A. DiCarlo *In its* Structural Ceramics May 1986 p 181-187 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11D

N88-23890*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POLYMER PRECURSORS FOR CERAMIC COMPOSITES
Frances I. Hurwitz *In its* Structural Ceramics May 1986 p 199-202 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11D

N88-23892*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIC FIBER REINFORCED REACTION-BONDED SI3N4 COMPOSITES
Ramakrishna T. Bhatt *In its* Structural Ceramics May 1986 p 213-222 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11D

N88-24427*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CREEP BEHAVIOR OF TUNGSTEN/NIOBIUM AND TUNGSTEN/NIOBIUM-1 PERCENT ZIRCONIUM COMPOSITES
D. W. Petrasek and R. H. Titran *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 267-272 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 11D

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N88-23841*# Brown Univ., Providence, R. I.
THEORETICAL STUDIES OF RESONANCE ENHANCED STIMULATED RAMAN SCATTERING (RESRS) OF FREQUENCY DOUBLED ALEXANDRITE LASER WAVELENGTH IN CESIUM VAPOR Progress Report, Jul. - Dec. 1987
Nabil M. Lawandy 1987 10 p
(Grant NAG5-526)
(NASA-CR-182871; NAS 1.26:182871) Avail: NTIS HC A02/MF A01 CSCL 07D

The third phase of research will focus on the propagation and energy extraction of the pump and SERS beams in a variety of configurations including oscillator structures. In order to address these questions a numerical code capable of allowing for saturation and full transverse beam evolution is required. The method proposed is based on a discretized propagation energy extraction model which uses a Kirchoff integral propagator coupled to the

three level Raman model already developed. The model will have the resolution required by diffraction limits and will use the previous density matrix results in the adiabatic following limit. Owing to its large computational requirements, such a code must be implemented on a vector array processor. One code on the Cyber is being tested by using previously understood two-level laser models as guidelines for interpreting the results. Two tests were implemented: the evolution of modes in a passive resonator and the evolution of a stable state of the adiabatically eliminated laser equations. These results show mode shapes and diffraction losses for the first case and relaxation oscillations for the second one. Finally, in order to clarify the computing methodology used to exploit the speed of the Cyber's computational speed, the time it takes to perform both of the computations previously mentioned to run on the Cyber and VAX 730 must be measured. Also included is a short description of the current laser model (CAVITY.FOR) and a flow chart of the test computations. Author

N88-23842 Northwestern Univ., Evanston, Ill.
THE STRUCTURE AND STABILITY OF SPHERICALLY EXPANDING FLAMES Ph.D. Thesis
John Kenneth Bechtold 1987 133 p
Avail: Univ. Microfilms Order No. DA8728959

A theoretical study is done to examine outwardly propagating spherical flames originating from a point ignition source in open space, soap bubbles, and spherical vessels. Spherically symmetric solutions are discussed for each of the three configurations. The stability of the solutions describing flames in open space and soap bubbles is tested. For flames in open space we account for both hydrodynamic and thermodiffusive effects. For Lewis numbers less than a critical value Le star less than 1, disturbances of the flame front grow during the initial phase of propagation, i.e., when the radius is comparable to the flame thickness. However, for Le greater than Le star, the flame, which is stable to thermodiffusive effects, becomes unstable only after a critical size is reached. This instability is hydrodynamic in nature and is caused by the thermal expansion of the gas. We provide an expression for the critical radius and show its dependence on the thermal expansion coefficient and on the Lewis number. The presence of a soap bubble causes a slight increase in pressure in the mixture inside the bubble. This in turn affects the growth of disturbances on the flame front. We show that if the surface tension is sufficiently large, then all disturbances decay. Thus surface tension at the bubble interface has a stabilizing effect on the flame.
Dissert. Abstr.

N88-23843 Yale Univ., New Haven, Conn.
CONTROL OF COMBUSTION AND ACOUSTICALLY COUPLED FLUID DYNAMIC INSTABILITIES Ph.D. Thesis
Surya Raghu [1987] 112 p
Avail: Univ. Microfilms Order No. DA8729130

The method of heat addition was used to successfully control oscillations in a Rijke tube, a whistler nozzle, resonance in a pipe set up by a loudspeaker, and a turbulent pipe flow with superimposed acoustic resonance. It was found that more control heat is necessary to suppress oscillations with a large background turbulent noise. Drag forces generated by fine screens were used to suppress the oscillations in a whistler nozzle. A feedback mechanism was designed to oscillate the screens in the proper phase to achieve the desired control action. The resonance in a pipe set up by a loudspeaker was suppressed by periodic mass addition using a feedback control system. Finally, a combination of screens and heating coils was used to control oscillations in a large combustion tunnel. The methods of control explored in this work are independent of the source of instability, and hence have a broad range of applications in real systems. Dissert. Abstr.

N88-23844 New South Wales Univ., Sydney (Australia). School of Chemical Engineering and Industrial Chemistry.
IMPROVEMENTS TO RANEY COPPER ZINC METHANOL SYNTHESIS CATALYSTS Ph.D. Thesis Abstract Only
Henry Edward Curry-Hyde May 1987 283 p
Avail: NTIS HC A13/MF A01

Properties of the catalysts prepared by leaching copper-aluminum-zinc alloy pellets in sodium hydroxide solution using a range of temperature and concentration conditions were studied. It was found that the surface area and specific activity of the catalyst pellets were adversely affected by high sodium hydroxide concentrations and high leach temperatures. The methanol yields in beds of catalyst produced in this way were limited by these effects. The copper crystallites in the leached structure increased in size while in contact with the sodium hydroxide solution, thereby reducing the surface area. Zn(OH)2(s) was precipitated in the leached copper structure during leaching. The specific activity of the Raney catalyst increased with an increase in the amount of zinc present on the catalyst surface. The decrease in specific activity of the catalysts prepared for the initial study was, therefore, attributed to the secondary leaching process that reduced the amount of zinc present on the surface. As a result, a new method of preparing Raney copper zinc catalyst by leaching the alloy in a sodium zincate-rich sodium hydroxide solution was proposed. This improved ZnO loadings and consequently higher specific activities. Studies on unpromoted and ZnO promoted Cu-Al2O3 surfaces showed that the hydrogenation of CO and CO2 to methanol occurred on copper surface surrounding the ZnO crystallites. The hydrogenation of CO2 was found to be the major route to methanol. Author

N88-23845* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MOVING WALL, CONTINUOUS FLOW ELECTRONPHORESIS APPARATUS Patent
Percy H. Rhodes, inventor (to NASA) and Robert S. Snyder, inventor (to NASA) 21 Jun. 1988 10 p Filed 5 Sep. 1986
Supersedes N87-18627 (25 - 11, p 1451)
(NASA-Case-MFS-28142-1; US-Patent-4,752,372; US-Patent-Appl-SN-904128; US-Patent-Class-204-299-R; US-Patent-Class-204-180.1) Avail: US Patent and Trademark Office CSCL 07D

This invention relates generally to electrophoresis devices and more particularly to a moving wall, continuous flow device in which an electrophoresis chamber is angularly positionable with respect to the direction of moving belt walls. A frame with an electrophoresis chamber is rotatably supported between two synchronously driven belt walls. This allows the chamber to be angularly positionable with respect to the direction of belt travel, which compensates for electroosmotic flow within the electrophoresis chamber. Injection of a buffer solution via an opening and a homogenous sample stream via another opening is performed at the end of a chamber, and collection of buffer and the fractionated species particles is done by a conventional collection array at an opposite end of the chamber. Belts are driven at a rate which exactly matches the flow of buffer and sample through the chamber, which entrains the buffer to behave as a rigid electrophoretic medium, eliminating flow distortions (Poiseuille effect). Additionally, belt material for each belt is stored at one end of the device and is taken up by drive wheels at an opposite end. The novelty of this invention particularly lies in the electrophoresis chamber being angularly positionable between two moving belt walls in order to compensate for electroosmotic flow. Additionally, new belt material is continuously exposed within the chamber, minimizing flow distortion due to contamination of the belt material by the sample.
Official Gazette of the U.S. Patent and Trademark Office

N88-23846* National Aeronautics and Space Administration. Pasadena Office, Calif.
METHOD OF EVAPORATION Patent
Eugene R. DuFresne 19 May 1987 9 p Filed 30 Jul. 1985
Continuation of US-Patent-Appl-SN-511363, Jul. 6, 1983, abandoned
(NASA-Case-NPO-15609-2; US-Patent-4,666,561; US-Patent-Appl-SN-761310; US-Patent-Class-203-90; US-Patent-Class-203-91; US-Patent-Class-203-98; US-Patent-Class-159-3; US-Patent-Class-159-48.2; US-Patent-Class-159-900; US-Patent-Appl-SN-511363) Avail: U.S. Patent and Trademark Office CSCL 07D

Liquids, such as juices, milk, molten metal and the like are concentrated by forming uniformly-sized, small droplets in a precision droplet forming assembly and deploying the droplets in free fall downwardly as a central column within an evacuated column with cool walls. A portion of the solvent evaporates. The vapor flows to the wall, condenses, and usually flows down the wall as a film to condensate collector and drain. The vertical column of freely falling droplets enters the splash guard. The condensate can be collected, sent to other towers or recycled.
Official Gazette of the U.S. Patent and Trademark Office

N88-23861# National Academy of Sciences - National Research Council, Washington, D. C.
AGENDA FOR ADVANCING ELECTROCHEMICAL SCIENCE AND TECHNOLOGY
William H. Smyrl, Stanley M. Wolf, and Albert R. Landgrebe *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 333-341 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 07D

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N88-23847# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Materials Integrity Branch.
PROCEEDINGS OF THE 1987 TRI-SERVICE CONFERENCE ON CORROSION, VOLUME 2 Final Report, Jan. 1986 - May 1987
Fred H. Meyer, Jr., ed. May 1987 473 p Conference held in Colorado Springs, Colo., 5-7 May 1987
(AD-A189660; AFWAL-TR-87-4139-Vol-2) Avail: NTIS HC A20/MF A01 CSCL 11F

The purpose of the conference was to continue interservice coordination of the areas of corrosion research and corrosion prevention and control. Specifically, the objectives were to make DOD personnel, contractors and interested parties aware of the important corrosion problems in military equipment, to present the status of significant corrosion research projects currently pursued by the military services and to provide a general forum for exchange of corrosion prevention and control information. For individual titles, see N88-23848 through N88-23864.

N88-23848# Raymond (Louis) and Associates, Newport Beach, Calif.
HYDROGEN EMBRITTLEMENT SUSCEPTIBILITY OF HIGH STRENGTH ESR 4340 STEEL ALLOYS FOR BALLISTICALLY RESISTANT/TOLERANT COMPONENTS
Louis Raymond and Albert A. Anctil (Army Materials Technology Lab., Watertown, Mass.) *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 3-15 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

The resistance of high strength steels to hydrogen embrittlement or hydrogen stress cracking is improved. Variations in heat treatment and modifications in alloy composition of electroslag remelted 4340 steel at 53 HRC were extensively explored. Threshold stress intensity parameter and damage tolerance index were target goals. In general, all alloy additions improve hydrogen assisted stress cracking (KIhem). The addition of 0.1 percent vanadium appears to be the most significant individual modification to ESR (electroslag remelted) 4340 steels. The results must be somewhat qualified because the hardness of ESR 4340V was 50 HRC instead of the intended 53 HRC. Silicon additions of about 1.5 percent tended to maximize the benefits from alloy modifications. Although within an alloy system the heat treatment effects were minor or secondary relative to alloy additions, the use of an intermediate quench and subzero cooling appeared to maximize the benefits from heat treatment. Increasing the threshold KIhem was not directly related to tempering temperature as anticipated. Overall, KIhem was increased from 10 ksi SQR (in) to a maximum value of about 15 ksi SQR (in). Author

N88-23849# Brookhaven National Lab., Upton, N. Y. Process Sciences Div.
POLYITACONIC ACID MACROMOLECULE PRIMER FOR ADHESIVE BONDING AND CORROSION CONTROL OF ALUMINUM
Toshifumi Sugama, L. E. Kukacka, and N. Carciello *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 16-28 Previously announced as N88-10173 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

When polyitaconic acid (PIA) macromolecules are applied as water soluble primers in polyurethane (PU) adhesive/aluminum adherend joint systems, they interact preferentially with the hydrated oxide aluminum to form hydrogen bonds, and with the isocyanate groups in the adhesive to yield polymer to polymer chemical bonding. This chemical coupling between the adhesive and adherend acts significantly to promote interfacial adhesive bonds. The arrangement of a near monolayer of PIA intermediate film plays a key role in governing the adhesion durability of the joint system and the corrosion resistance of the aluminum upon exposure to corrosive fluids. The bond stability and the corrosion resistance are due primarily to the formation of interfacial reaction products which are less susceptible to hydrolysis. Author

N88-23850# Army Materials Technology Lab., Watertown, Mass.
CORROSION AND CORROSION INHIBITION OF METALS/ALLOYS IN METHYPHOSPHONIC DIFLUORIDE
Chester V. Zabielski and Milton Levy *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 70-108 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

Electrochemical potentiodynamic polarization studies were carried out for a variety of ferrous and nonferrous metals in methylphosphonic difluoride. Studies of the effect of organic inhibitors on the corrosion rate of 1020 steel, 316 and 304 stainless steel and magnesium in methylphosphonic difluoride were also carried out. Author

N88-23851# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
DEVELOPMENT OF MICROENCAPSULATED DNBM QUATERNARY AMMONIUM INHIBITORS FOR PAINTS c27
Lionel J. Bailin and Vinod S. Agarwala (Naval Air Development Center, Warminster, Pa.) *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 111-127 (For primary document see N88-23847 17-26)
(Contract N62269-85-C-0218)
Avail: NTIS HC A20/MF A01 CSCL 11B

The microencapsulation of DNBM quaternary ammonium corrosion inhibitors (dichromate, nitrite, borate, and molybdate) for use in epoxy polyamide primers on Naval aircraft was accomplished using a cellulose ether as the outer shell with a deactivating step applied to render the shell impermeable to the primer solvents during cure. The microcapsules are in the 5 to 30 micron particle size range, and were prepared to contain 30, 55, and 70 percent DNBM. These inhibitors were developed to retard corrosion fatigue and stress corrosion cracking in high strength steels and aluminum alloys. Corrosion testing is underway. Author

N88-23852# Naval Air Development Center, Warminster, Pa.
INADEQUACIES OF EMI-SEAL MATERIAL: A CORROSION STUDY
Vinod S. Agarwala, Richard C. Paciej, and James J. Thompson *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 128-141 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

Electromagnetic interference (EMI) seals are mandatory for all structural joints in Naval aircraft because of the high

electromagnetic environment present on aircraft carriers. Currently, a major component used in these seals is a 20 percent Zn/Sn coating arc sprayed onto an Al alloy substrate. This coating was found to cause major structural damages when exposed to Naval environments. Pits up to 35 mils deep on the Al alloy have been observed under the seal after one year of service on F/A-18 aircraft. A study of this material, 20 percent Zn/Sn arc spray coating, was reported in terms of its compatibility with the substrate metal in Naval environments. Author

N88-23853# Rockwell International Science Center, Thousand Oaks, Calif.
STRESS CORROSION CRACKING PROPERTIES OF Al-Li ALLOYS
J. B. Lumsden and A. T. Allen *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 142-149 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

Aluminum-lithium alloys have received much attention recently, because of their potential for weight savings, with increased stiffness, in many types of aerospace vehicles. Conventional aluminum alloys can fail by intergranular stress corrosion cracking (SCC) in specific environments, which has necessitated the development of alloy compositions and heat treatments to increase SCC resistance. Although experience with conventional Al alloys suggests SCC could be a potential problem in Al-Li alloys, the environmental effects for this family of alloys were measured only to a limited extent. The SCC behavior of Al-Li alloys exposed to chloride solutions were assessed, and the effects of strain rate, aging treatments and potential was examined. Author

N88-23854# Naval Surface Weapons Center, Silver Spring, Md.
CORROSION OF TUNGSTEN ALLOYS IN MARINE ENVIRONMENTS
K. L. Vasanth and C. M. Dacres *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 165-186 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

Tungsten alloys are important for Navy application because of their high density and strength. Very little information is available about the corrosion behavior of these alloys, although W is known to be corrosion resistant. The corrosion behavior of five W alloys in 3.5 percent NaCl was characterized using electrochemical and gravimetric tests. Laboratory results are compared to results obtained from exposure to natural sea water. The uniform corrosion rate of the alloys considered were found to be under 2 mils per year. However, alloys designated S1 and S2 exhibited preferential local attack. The corrosion in these alloys occur between W particles where matrix alloy precipitated. Such an attack affects the strength of these alloys leading to fracture, particularly under the conditions of impact and load. Author

N88-23855# Naval Surface Weapons Center, Silver Spring, Md.
CORROSION AND FATIQUE PROPERTIES OF FeCrB/Si METALLIC GLASS WIRES IN AQUEOUS ENVIRONMENTS
Anh H. Le and Lawrence T. Kabacoff *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 187-201 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

Measurements were made of the corrosion and fatigue properties of metallic glass wires of composition Fe75-xCrxB15Si10 (x = 5, 8, 11) in air, deionized water, 3.5 w/o NaCl and 1.0 H2SO4. A clear inverse relationship was observed between the corrosion rate and the number of cycles to failure. Fatigue limits were observed for those cases where spontaneous passivation occurs (all compositions in air and deionized water, and 8 and 11 a/o Cr in chloride solution). It was found that the mechanism for the fatigue failure of specimens which spontaneously passivate differs from that of metallic glasses in acidified chloride environment where active/passive behavior is observed. A model is proposed to explain this observation. Author

N88-23856# Minnesota Mining and Mfg. Co., St. Paul.
SURFACE CONDITIONING PRODUCTS AS TOOLS FOR CORROSION REMOVAL AND CORROSION PREVENTION
Joseph J. Claus *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 205-219 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

Three dimensional abrasive products have a long history of use in corrosion prevention and corrosion repair. Not only do they generate better surfaces for painting and coating, thus offering better protection, but they are used for stress control and to remove corrosion and deteriorated coatings. The ability of these products to perform in corrosion related situations is described. Specific application areas, such as munitions reclaimation, airframe maintenance, ground vehicle repair and plant refurbishing, are highlighted. Additionally, the chemical nature of a surface together with its physical characteristics are shown to be the foundation for corrosion prevention. Author

N88-23857# Naval Surface Weapons Center, Silver Spring, Md. Corrosion Technology Group.
THE EFFECT OF TITANIUM REINFORCEMENT ON THE LIFE OF POSITIVE GRIDS IN LEAD-ACID BATTERIES c33
W. A. Ferrando and K. L. Vasanth *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 220-234 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 10C

Positive grid failure by various corrosion mechanisms is an important life limiting factor in lead-acid secondary batteries. A 5 to 6 year life cycle is currently typical for such batteries in both commercial and military use. Significantly increased ship availability and cost savings to the Navy can be anticipated with the incorporation of batteries of reinforced positive grid design into its vessels. The results of comparative data on titanium wire reinforced and unreinforced large lead alloy positive grids under accelerated positive potential float corrosion test are presented. Uniform and intergranular corrosion and grid growth is reported. A reliable estimate is made of reinforced grid service life. In turn, a confident projection of at least a 10 year cell operational life can be made. Author

N88-23858# Sermatech International, Inc., Limerick, Pa.
RECENT ADVANCES IN METALLIC/CERAMIC COATINGS FOR CORROSION CONTROL IN MILITARY APPLICATIONS c27
Mark F. Mosser *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 259-279 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11B

Recent advances in metallic/ceramic coatings are described which meet the MIL-C-81751B specification and related corrosion/oxidation resistant chromate or phosphate finishes. A brief history of the generic coating family is followed by detailed descriptions of the improved coating processes. Coating advances are described in three general areas. In the first, improved sealed coating systems are presented. These sealed coatings have superior corrosion resistance and improved erosion resistance when compared to conventional coatings. The second area relates to coating processes designed for gun barrels and other ordnance hardware. The third area described includes coatings specifically designed for operation in harsh acid rain environments including SOx, NOx and acid halide exposure conditions. Test results include heat cycling and acid exposure data on several alloys used in turbine compressors. Author

N88-23859# Lehigh Univ., Bethlehem, Pa. Dept. of Chemistry.
CARBOXYLATE FORMATION AT THE INTERFACE BETWEEN A POLYIMIDE COATING AND COBALT c27
Richard D. Cranata, Philip D. Deck, and Henry Leidheiser, Jr. *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 280-302 Sponsored by ONR, Washington, D.C. (For primary document see N88-23847

17-26)
Avail: NTIS HC A20/MF A01 CSCL 11B

The interfacial region between a polymer coating and a metal substrate was studied using three techniques. Each technique permitted interface integrity and was performed under normal atmospheric pressure conditions. Infrared analysis of the polymer at the interface was accomplished by using an internal reflectance technique through an optically thin metal film. A second infrared technique employed photoacoustic spectroscopy of thin polymer films on high surface area metal substrates. Emission Moessbauer spectroscopy, made surface sensitive by depositing less than a monolayer of Co-57 on a Co substrate, permitted evaluation of the chemical changes occurring on the Co substrate as a result of polymer coating application and cure. Each technique revealed the presence of metal carboxylates within the interfacial region. These carboxylates may provide primary bonding between coating and substrate. Author

N88-23860# Naval Research Lab., Washington, D.C.
ION BEAM ALLOYING OF ALUMINUM FOR CORROSION RESISTANCE
P. M. Natishan, E. McCafferty, and G. K. Hubler *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 303-332 Sponsored by ONR, Arlington, Va. (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

Ion beam alloying techniques overcome many of the problems associated with conventional alloying. Novel aluminum surface alloys were prepared by ion implanting Al with Si, Zr, Nb, Cr, Mo, Zn, or Al at nominal concentration of 4 or 12 atomic percent. The results showed that implantation with Cr, Si, Mo, Zr, and Nb produced surface alloys that were more resistant to pitting than Al, and that implantation with Zn produced a surface alloy that was less resistant to pitting attack. The implantation of Al into Al had no effect on the pitting potential, indicating that the increased and decreased pitting potentials observed for the other implants was a chemical effect. The increased and decreased pitting resistance of the surface alloys was related to the surface charge character of the oxide film. The pit morphology indicated that blister formation and rupture, caused by gas production at the oxide/metal interface, was an important part of pit propagation. Author

N88-23861# National Academy of Sciences - National Research Council, Washington, D. C.
AGENDA FOR ADVANCING ELECTROCHEMICAL SCIENCE AND TECHNOLOGY c25
William H. Smyrl, Stanley M. Wolf, and Albert R. Landgrebe *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 333-341 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 07D

The economic cost of corrosion in the U.S. has been estimated to be about $120 billion (1982). A study led to the conclusion that a new approach to corrosion science and corrosion engineering is not only necessary but possible. The required capabilities are becoming available in the scientific ability to model surfaces and interfaces, in the electrochemical and surface science techniques for studying interfaces in situ, in the computational facilities for modeling, and in materials processing technology. Six central recommendations were identified on theory and modeling, experimental probes, lifetime prediction, investigation of advanced materials, multidisciplinary efforts, and education. These six recommendations are briefly detailed. Author

N88-23862# Minnesota Mining and Mfg. Co., St. Paul. Adhesives, Coatings and Sealers Div.
WATER BASED PRIMERS FOR STRUCTURAL ADHESIVE BONDING OF AIRCRAFT c27
A. V. Pocius and T. H. Wilson, Jr. *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 343-358 Previously announced in IAA as A88-32992 (For primary document see N88-23847 17-26)
(Contract F33615-86-R-5009)
Avail: NTIS HC A20/MF A01 CSCL 11B

Physical, coating and performance characteristics of three new primers useful for structural adhesive bonding of aircraft are discussed. The most evident characteristic of these new primers is that they are primarily water vehicled primers in contrast to today's primers which are primarily solvent vehicled. Thus, these primers meet the stricter pollution control regulations now found in many states. Two of these primers, XB-3982, and XB-3983, can be spray applied using conventional methods and provide performance characteristics equivalent to today's solvent vehicled primers. Thus, these new primers can directly replace their solvent based analogs. The third primer, XA-3995, is a cathodic electrophoretically applied structural adhesive bonding primer. This primer is primarily water vehicled and provides good high temperature performance. In addition, the cathodic electrophoretic application method allows for uniform, reproducible application of thin coatings of primer with very efficient utilization of material. Author

N88-23863# Lockheed-Georgia Co., Marietta.
PREVENTING AIRCRAFT CORROSION BY PREDICTIVE CORROSION MODELING
Robert N. Miller and Fred H. Meyer, Jr. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.) *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 359-385 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

Aircraft maintenance scheduling is optimized through the use of a predictive corrosion model which is based on the kinetics of corrosion reactions, the degradation rates of protective systems and the environmental conditions at Air Force bases. A VAX-11 FORTRAN computer program was developed which enables the analysis of specific points on the C-5 aircraft and, utilizing environmental factors and the time periods an aircraft has been at various A.F. bases, gives recommended times for inspection and maintenance. The computer programs include a crack growth module which calculates the remaining flight hours until theoretical cracks grow to half their critical length, a corrosion module which computes the time for exposed aircraft alloys to corrode to a depth of 3 mils, and a coating degradation module which determines the optimum time until the next paint renewal or complete repaint operation. The predictive model, when completed, will be used to optimize field and depot level maintenance for aircraft now in operation, inspection and maintenance schedules for new aircraft, and selection of aircraft for Analytical Condition Inspection. Author

N88-23864# Naval Research Lab., Washington, D.C. Chemistry Div.
VANADIC HOT CORROSION OF GAS TURBINE BLADE COATING MATERIALS
R. L. Jones *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 386-411 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11F

In anticipation of possible future use of vanadium containing fuel in ship propulsion gas turbines, studies were made at NRL on vanadium effects in the hot corrosion of CoCrAlY, a current blade coating, and of stabilized zirconia (ZrO_2), a ceramic being developed as a blade coating for gas turbines. Both materials were attacked under conditions of high V_2O_5 activity, with an outer layer of Co vanadate being formed on CoCrAlY which, sometimes, gave an apparent inhibition of corrosion. Vanadic attack on ZrO_2 caused depletion of the stabilizing oxides (Y_2O_3 or CeO_2) and degradation of the ceramic. The corrosion processes for both materials are similar in many aspects, being in each case predominantly controlled by Lewis acid-base reactions between the molten salt/combustion gas species (Na_2O, V_2O_5, SO_3) and coating oxides (CoO, Y_2O_3, CeO_2). A discussion is given on the potential application of oxide acid-base theory to develop

corrosion-proof stabilized ZrO2 coatings by, e.g., identifying new stabilizing oxides which are more resistant than Y2O3 to acidic (vanadic) corrosion. Author

N88-23865# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
AC IMPEDANCE ANALYSIS OF CORROSION FATIGUE IN NAVAL AIRCRAFT ALLOYS Final Report, 10 Aug. 1985 - 30 Nov. 1986
M. Kendig and F. Mansfield May 1987 60 p
(Contract N62269-85-R-0248; DA Proj. R02202)
(AD-A190822; SC5436.2FR; NADC-87183-60) Avail: NTIS HC A04/MF A01 CSCL 11F

The objective of this program is to develop rapid electrochemical methods for evaluating the susceptibility of Naval aircraft materials to corrosion fatigue (CF). A fatigue admittance method that evaluates the coupling of the modulated stress intensity factor to electrochemical reaction kinetics has been developed. In addition, phase sensitive detection of the crack tip displacement allows continuous measurement of the CF rate as a function of time and potential. Application of fatigue admittance analysis to the CF of Al 7075-T73 demonstrates that the crack tip of the material in aerated 0.5 M NaCl is anodic to the nonoccluded surface of the material. Injection of a corrosion inhibitor dichromate, nitrite, borate and molydbate (DNBM) into the crack tip decreases the extent to the anodic polarization of the crack tip and decreases the electrochemical rate of oxidation in the crack tip by a factor of 100. The role of aqueous and organic phase dichromate, nitrite, borate and molydbate (DNBM) on the CF rate of 4340 steel in 0.5 NaCl has also been evaluated. The organic complex DNBM when injected in the crack tip reduces the crack growth rate by a factor of 10. The aqueous inhibitors at a concentration level of 0.01 M show only small influences on the open CF rate, but 0.01 M borate reduces the cathodically aerated CF. GRA

N88-23866# Centre d'Essais Aeronautique Toulouse (France). Lab. des Materiaux Metalliques Refractaires.
BRIEF EVALUATION OF THE ALLOY 17-4-PH (Z5 CNU 17-04). SEMIFINISHED PRODUCT: 205 mM DIA FORGED ROLLER, TEST REPORTS [EVALUATION SOMMAIRE DE L'ALLIAGE 17-4-PH (Z5CNU17-04). DEMI-PRODUIT: GALET FORGE DIA 205 MM. PROCES VERBAUX M4-487000 ET M4-494300]
M. Notton 13 Oct. 1987 93 p In FRENCH
(DF/NH-3616/84; M4-487000; M4-494300; ETN-88-92298)
Avail: NTIS HC A05/MF A01

Characterization of forged steel rollers and the influence of simulated aging corresponding to 1000 hr service at 350 C are summarized. Fatigue, tensile, toughness, crack propagation, and metallographic properties were tested. Aging effects are manifested mainly through a slight improvement in R and RO.2 to the detriment of K Charpy-V toughness. Fatigue properties are weaker, especially at 400 C. Aging appears to have no effect on crack propagation rate. ESA

N88-23867 New South Wales Univ., Sydney (Australia).
COMPLEXATION AND HYDROLYSIS REACTIONS OF IRON(III) Ph.D. Thesis Abstract Only
G. H. Khoe Jun. 1987 219 p
Avail: Issuing Activity

The complexation and hydrolysis of iron(III) was investigated by potentiometric titration using a glass electrode at 25 C. The hydrolysis investigation was carried out in 1 mol/cu dm KNO3, NaClO4 and KCl medium and was extended to include the ternary system iron(III)-water-sulphate in 1 mol/cu dm NaNO3 medium. The complexation of iron(III) with phosphate and arsenate ion has also been investigated in the same manner in 3.0 mol/cu dm NaNO3. The titrations of the hydrolyzed iron(III) solutions were concluded after pH relaxation (a downward drift in pH readings which precedes the appearance of turbidity) was observed. The onset of pH relaxation (at pH greater than 2.0) is probably caused by the commencement of the hydrolytic polymerization reactions, and was used to determine precisely, within 0.002 pH units, the titration end point for the solution equilibrium region. Species distributions in solution at the onset of pH relaxation were calculated using the equilibrium models determined in the present work. The species distribution calculations show that the value of j in both 1 mol/cu dm KNO3 and 1 mol/cu dm NaClO4 medium is 0.0, in 1 mol/cu dm KCl 0.5, and in 1 mol/cu dm NaNO3 in the presence of sulphate, 0.6. Author

N88-24278# Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy Lab.
THE ROLE OF OXYGEN ON THE MECHANICAL BEHAVIOR OF MOLYBDENUM ALLOYS
J. Wadsworth, T. G. Nieh, W. C. Coons, and J. J. Stephens (Sandia National Labs., Albuquerque, N. Mex.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 97-101 (For primary document see N88-24254 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A22/MF A01

N88-24279*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY STUDY OF NIOBIUM ALLOY CONTAMINATION BY TRANSPORT THROUGH HELIUM
C. M. Scheuermann, T. J. Moore, and D. R. Wheeler *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 103-106 Sponsored by DOE, Washington, D.C. and DOD, Washington, D. C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 11F

N88-24408# Oak Ridge National Lab., Tenn.
ENHANCED EMITTANCE OF OXIDIZED 304 STAINLESS STEEL
R. E. Pawel, D. L. McElroy, R. S. Graves, and J. J. Campbell *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 163-166 (For primary document see N88-24374 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A99/MF A01

N88-24447# Oak Ridge National Lab., Tenn.
REVIEW OF ALKALI METAL AND REFRACTORY ALLOY COMPATIBILITY FOR RANKINE CYCLE APPLICATIONS
James R. DiStefano *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 355-360 (For primary document see N88-24374 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A99/MF A01

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N88-23868# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
DISCLINATION STRUCTURES IN CARBON AND GRAPHITE
Jack L. White 31 Dec. 1987 31 p
(Contract F04701-85-C-0086)
(AD-A191056; TR-0086(6728-01)-1; SD-TR-87-60) Avail: NTIS HC A03/MF A01 CSCL 11B

Carbon materials are structurally unique, owing to their relationship to liquid crystals. Pyrolysis of precursors that pass through a liquid crystalline (mesophase) state is the process by which most carbons form. The lamelliform morphologies that are locked in as the carbonaceous mesophase hardens lack grain boundaries but possess disclinations as their most prominent structural feature. Practical materials, ranging in value from petroleum coke to mesophase carbon fiber, form while the mesophase undergoes deformation, and the disclinations can react extensively before they are entrapped by hardening. Thus, most

carbons and graphites may be regarded as mesophase fossils with disclination-dominated microstructures that vary with the nature and extent of deformation and with the time allowed for the disclinations to react and relax before hardening. GRA

N88-23869# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
THE PERFORMANCE OF PERFLUOROPOLYALKYLETHER OILS UNDER BOUNDARY LUBRICATION CONDITIONS
David J. Carre 15 Feb. 1988 22 p
(Contract F04701-85-C-0086)
(AD-A191057; TR-0086A(2945-03)-4; SD-TR-88-14) Avail: NTIS HC A03/MF A01 CSCL 11H

Perfluoropolyalkylether (PFPE) oils and oil-based greases are being used with increasing frequency on spacecraft as a result of their purported outstanding properties. We demonstrated that, under boundary lubrication, these materials degrade by way of an autocatalytic mechanism. As a result, they have serious limitations in this tribological regime primarily because of the inability of the PFPE fluids to dissolve antiwear additives. To augment the fundamental studies, a series of wear tests comparing PFPE oils and greases with hydrocarbon fluids under boundary conditions were performed. As predicted, the performances of the PFPE fluids were below that of the hydrocarbon fluids. The results of the wear tests are discussed in terms of the effect of additives on the PFPE degradation mechanism and the overall usefulness of the PFPE fluids under boundary lubrication conditions. GRA

N88-23870# Ecole des Mines, Paris (France).
MECHANICAL AND STRUCTURAL CHARACTERIZATION OF ALUMINUM CERAMIC FIBERS [CARACTERISATION MECANIQUE ET STRUCTURALE DES FIBRES CERAMIQUES D'ALUMINE]
C. Lesniewski and A. R. Bunsell Mar. 1987 54 p In FRENCH
(Contract DRET-84-34-115-00-470-75-01)
(ETN-88-92168) Avail: NTIS HC A04/MF A01

Aluminum/silicon fibers made by Sumitomo were compared with Dupont alpha aluminum fibers in tensile tests, completed with differential thermal analysis, X-ray diffraction, infrared spectroscopy, and transmission and scanning microscopy. Results show that although the Sumitomo fibers are much better than those of Dupont, their utilization is limited to 1100 C. The drop in mechanical properties precludes their use, even for short periods. For longer periods of utilization, at different temperatures above and below 1100 C, fiber structure changes to mullite. ESA

N88-23871 New South Wales Univ., Sydney (Australia).
MODIFICATION OF POLYMERS BY PHOTOGRAFTING PROCESSES Ph.D. Thesis Abstract Only
Lloyd Geldard Dec. 1986 464 p
Avail: Issuing Activity

Results are presented of photografting methyl methacrylate onto polypropylene substrate enhanced by a synergistic mixture of benzophenone with a range of alkyl aliphatic amines. The effectiveness of amines as synergists with benzophenone in photografting reactions decreased in the order tertiary, secondary and primary. It is concluded that the mechanism of photoreduction of benzophenone by tertiary amines and by secondary/primary amines occurred by formation of alpha-aminoalkyl and aminylalkyl radicals respectively. It is proposed that the trend in photografting as a function of class of amine is due to a lower reactivity of aminylalkyl radicals than alpha-aminoalkyl radicals in initiating polymerization processes. The existence of ground state amine-benzophenone complexes is postulated to account for the absence of a correlation between length of N-alkyl chains and synergistic effectiveness in photografting. It is proposed that the mechanism of initiation of polymerization of acrylate monomers by amine-benzophenone synergists proceeds by either catalysis of addition of an amine-derived radical onto monomer within a ternary complex or the operation of a hydrogen transfer repair mechanism within a ternary complex. In each case this ternary complex subsequently decomposes and initiates chain propagation of acrylate monomers. Author

N88-23872*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRUCTURAL CERAMICS
May 1986 226 p Workshop held in Cleveland, Ohio, 20-21 May 1986 Sponsored by NASA, Washington
(NASA-CP-2427; E-3063; NAS 1.55:2427) Avail: NTIS HC A11/MF A01 CSCL 11B

This publication is a compilation of abstracts and slides of papers presented at the NASA Lewis Structural Ceramics Workshop. Collectively, these papers depict the scope of NASA Lewis' structural ceramics program. The technical areas include monolithic SiC and Si3N4 development, ceramic matrix composites, tribology, design methodology, nondestructive evaluation (NDE), fracture mechanics, and corrosion. For individual titles, see N88-23873 through N88-23892.

This publication is a compilation of abstracts and slides of papers presented at the NASA Lewis Structural Ceramics Workshop. Collectively, these papers depict the scope of NASA Lewis' structural ceramics program. The technical areas include monolithic SiC and Si3N4 development, ceramic matrix composites, tribology, design methodology, nondestructive evaluation (NDE), fracture mechanics, and corrosion.

N88-23873*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CERAMICS FOR TURBINE ENGINES
Stanley R. Levine *In its* Structural Ceramics May 1986 p 1-13 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11C

The Ceramics for Turbine Engines Project is comprised of three main research programs with major elements as indicated: materials and processing (monolithics and fiber reinforcement), design methodology (design code and tribology), and life prediction (environmental effects, nondestructive evaluation, fracture and fatigue, and time dependent behavior). From the NASA perspective an enhanced ceramics technology base directly supports aeronautics initiatives in small engine technology, high-performance turbine engine technology, and hypersonics. An overview of the program, which includes the technical objectives and content of each program, is provided. B.G.

N88-23874*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRICTION AND WEAR OF CERAMICS
Donald H. Buckley *In its* Structural Ceramics May 1986 p 15-22 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11C

The adhesion, friction, wear, and lubricated behaviors of both oxide and non-oxide ceramics are reviewed. Ceramics are examined in contact with themselves, other harder materials, and metals. Elastic, plastic, and fracture behavior of ceramics in solid state contact is discussed. The contact load necessary to initiate fracture in ceramics is shown to be appreciably reduced with tangential motion. Both friction and wear of ceramics are anisotropic and relate to crystal structure as with metals. Grit size effects in two and three body abrasive wear are observed for ceramics. Both the free energy of oxide formation and the d valence bond character of metals are related to the friction and wear characteristics for metals in contact with ceramics. Surface contaminants affect friction and adhesive wear. For example, carbon on silicon carbide and chlorine on aluminum oxide reduce friction while oxygen on metal surfaces in contact with ceramics increases friction. Lubrication increases the critical load necessary to initiate fracture of ceramics both in indentation and with sliding or rubbing. Author

N88-23875*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME DESIGN CONSIDERATIONS FOR CERAMIC COMPONENTS IN HEAT ENGINE APPLICATIONS
John P. Gyekenyesi *In its* Structural Ceramics May 1986 p 23-33 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11C

The design methodology for brittle material structures which is being developed and used at the Lewis Research Center for sizing ceramic components in heat engine applications is reviewed. Theoretical aspects of designing with structural ceramics are discussed, and a general purpose reliability program for predicting fast fracture response due to volume distributed flaws is described. Statistical treatment of brittle behavior, based on the Weibull model, is reviewed and its advantages, as well as drawbacks, are listed. A mechanistic statistical fracture theory, proposed by Batdorf to overcome the Weibull model limitations and based on Griffith fracture mechanics, is summarized. Failure probability predictions are made for rotating annular Si3N4 disks using various fracture models, and the results are compared to actual failure data. The application of these design methods to Government funded ceramics engine demonstration programs is surveyed. The uncertainty in observed component performance emphasizes the need for proof testing and improved nondestructive evaluation to guarantee adequate structural integrity. Author

N88-23876*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONDESTRUCTIVE EVALUATION OF STRUCTURAL CERAMICS **c38**
Alex Vary *In its* Structural Ceramics May 1986 p 35-46 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 14D

Research on nondestructive evaluation (NDE) of structural ceramics for heat engine applications is reviewed. Microfocus radiography and scanning laser acoustic microscopy are the NDE techniques highlighted. The techniques were applied to research samples of sintered silicon nitride and silicon carbide in the form of modulus-of-rupture (MOR) bars. The strength and limitations of the aforementioned techniques are given in terms of probabliity of detection for voids in green and sintered MOR bars. Voids for this purpose were introduced by seeding green ceramic bars and characterizing each void in terms of its size, shape, location, and nature before and after sintering. The effects of material density, microstructure, surface finish, thickness, void depth, and size characteristics on detectability are summarized. Author

N88-23877*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRACTURE MECHANICS **c39**
John L. Shannon, Jr. *In its* Structural Ceramics May 1986 p 47-57 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 20K

The application of fracture mechanics to the design of ceramic structures will require the precise measurement of crack growth and fracture resistance of these materials over their entire range of anticipated service temperatures and standardized test methods for making such measurements. The development of a standard test for measuring the plane strain fracture toughness is sought. Stress intensity factor coefficients were determined for three varieties of chevron-notch specimens, and fracture toughness measurements were made on silicon nitrides, silicon carbides, and aluminum oxides to assess the performance of each specimen variety. It was determined that silicon nitride and silicon carbides have flat crack growth resistance curves, but aluminum oxide does not. Additionally, batch-to-batch differences were noticed for the aluminum oxide. Experiments are continuing to explain the rising crack growth resistance and batch-to-batch variations for the aluminum oxide. Author

N88-23878*# Washington Univ., Seattle. Brittle Materials Design Program.
STRUCTURAL CERAMICS RESEARCH **c39**
J. I. Mueller, R. J. H. Bollard, and R. C. Bradt *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 59-62 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 20K

Ceramic research at the University of Washington, brittle materials design program, and NASA program research at the University of Washington are outlined. B.G.

N88-23879*# Ford Motor Co., Dearborn, Mich.
IMPROVED SILICON CARBIDE FOR ADVANCED HEAT ENGINES
Thomas J. Whalen and J. A. Mangels *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 63-88 (For primary document see N88-23872 17-27)
(Contract NAS3-24384)
Avail: NTIS HC A11/MF A01 CSCL 11C

The development of silicon carbide materials of high strength was initiated and components of complex shape and high reliability were formed. The approach was to adapt a beta-SiC powder and binder system to the injection molding process and to develop procedures and process parameters capable of providing a sintered silicon carbide material with improved properties. The initial effort was to characterize the baseline precursor materials, develop mixing and injection molding procedures for fabricating test bars, and characterize the properties of the sintered materials. Parallel studies of various mixing, dewaxing, and sintering procedures were performed in order to distinguish process routes for improving material properties. A total of 276 modulus-of-rupture (MOR) bars of the baseline material was molded, and 122 bars were fully processed to a sinter density of approximately 95 percent. Fluid mixing techniques were developed which significantly reduced flaw size and improved the strength of the material. Initial MOR tests indicated that strength of the fluid-mixed material exceeds the baseline property by more than 33 percent. the baseline property by more than 33 percent. B.G.

N88-23880*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRENGTH OPTIMIZATION OF ALPHA-SiC BY IMPROVED PROCESSING
Sunil Dutta *In its* Structural Ceramics May 1986 p 89-98 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11C

Silicon carbide is of great interest for structural use in aircraft and automobile engines. This ceramic combines high thermal conductivity and low coefficient of thermal expansion, and consequently has good thermal shock resistance. However, like other ceramics, silicon carbide shows strength variability due to processing flaws such as large voids, shrinkage cracks, and inclusions. Agglomerates in the starting powder seem to be the predominant cause of such defects. Improved processing techniques such as slurry pressing and hot isostatic pressing (HIP) were employed to minimize these defects and to improve strength and reliability in the fabricated material. For this purpose 2-inch diameter disks were fabricated by various consolidation techniques. These include: dry pressing and sintering, slurry pressing and sintering, and slurry pressing and HIPing. The results are discussed. Author

N88-23881*# AiResearch Mfg. Co., Torrance, Calif.
IMPROVED SILICON NITRIDE FOR ADVANCED HEAT ENGINES
H. C. Yeh and J. M. Wimmer (Garrett Turbine Engine Co., Phoenix, Ariz.) *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 99-116 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11C

Silicon nitride is a high temperature material currently under consideration for heat engine and other applications. The objective is to improve the net shape fabrication technology of Si3N4 by injection molding. This is to be accomplished by optimizing the process through a series of statistically designed matrix experiments. To provide input to the matrix experiments, a wide range of alternate materials and processing parameters was investigated throughout the whole program. The improvement in the processing is to be demonstrated by a 20 percent increase in strength and a 100 percent increase in the Weibull modulus over that of the baseline material. A full characterization of the baseline process was completed. Material properties were found to be highly dependent on each step of the process. Several important

parameters identified thus far are the starting raw materials, sinter/hot isostatic pressing cycle, powder bed, mixing methods, and sintering aid levels. Author

N88-23882*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVED PROCESSING OF Si3N4
William A. Sanders and George Y. Baaklini (Cleveland State Univ., Ohio.) *In its* Structural Ceramics May 1986 p 119-127 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11C

A sintered Si3N4-SiO2-Y2O3 composition, NASA 6Y, was developed that reached four-point flexural average strength/standard deviation values of 857/36, 544/33, and 462/59 MPa at room temperature, 1200, and 1370 C, respectively. These strengths represented improvements of 56, 38, and 21 percent over baseline properties at the three test temperatures. At room temperature the standard deviation was reduced by more than a factor of three. These accomplishments were realized by the iterative utilization of conventional X-radiography to characterize structural (density) uniformity as affected by systematic changes in powder processing and sintering parameters. Accompanying the improvement in mechanical properties was a change in the type of flaw causing failure from a pore to a large columnar beta-Si3N4 grain typically 40 to 80 microns, 10 to 30 microns wide, and with an aspect ratio of 5:1. Author

N88-23883*# Case Western Reserve Univ., Cleveland, Ohio.
COLLOIDAL CHARACTERIZATION OF SILICON NITRIDE AND SILICON CARBIDE
Donald L. Feke *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 129-138 (For primary document see N88-23872 17-27)
(Grant NAG3-468)
Avail: NTIS HC A11/MF A01 CSCL 11C

The colloidal behavior of aqueous ceramic slips strongly affects the forming and sintering behavior and the ultimate mechanical strength of the final ceramic product. The colloidal behavior of these materials, which is dominated by electrical interactions between the particles, is complex due to the strong interaction of the solids with the processing fluids. A surface titration methodology, modified to account for this interaction, was developed and used to provide fundamental insights into the interfacial chemistry of these systems. Various powder pretreatment strategies were explored to differentiate between true surface chemistry and artifacts due to exposure history. The colloidal behavior of both silicon nitride and carbide is dominated by silanol groups on the powder surfaces. However, the colloid chemistry of silicon nitride is apparently influenced by an additional amine group. With the proper powder treatments, silicon nitride and carbide powder can be made to appear colloidally equivalent. The impact of these results on processing control will be discussed. Author

N88-23884*# General Motors Corp., Indianapolis, Ind. Allison Gas Turbine Div.
NONDESTRUCTIVE EVALUATION (NDE) OF STRUCTURAL CERAMICS BY PHOTOACOUSTIC MICROSCOPY c38
P. K. Khandelwal *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 139-145 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 14D

Photoacoustic microscopy (PAM) was utilized to detect surface and subsurface defects in structural ceramic materials. A computerized PAM data acquisition, color imaging and analysis system was developed and used. Subsurface simulated cylindrical holes can be detected to about 1 mm below the interrogating surface. Simulated tight surface cracks of 96 microns length and 48 microns depth can be detected in these materials under optimum conditions. Author

N88-23885*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MOLTEN SALT CORROSION OF SIC AND Si3N4
N. S. Jacobson, J. L. Smialek, and D. S. Fox *In its* Structural Ceramics May 1986 p 147-162 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11C

The most severe type of corrosion encountered in heat engines is corrosion by molten sodium sulfate, formed by the reaction of ingested sodium chloride and sulfur impurities in the fuel. This problem was studied extensively for superalloys, but only recently examined for ceramics. This problem is addressed with laboratory studies to understand the fundamental reaction mechanisms and with burner studies to provide a more realistic simulation of the conditions encountered in a heat engine. In addition the effect of corrosion on the strengths of these materials was assessed. Each of these aspects will be reviewed and some ideas toward possible solutions will be discussed. Author

N88-23886*# Garrett Turbine Engine Co., Phoenix, Ariz.
THERMAL CYCLIC DURABILITY TESTING OF CERAMIC MATERIALS FOR TURBINE ENGINES c38
L. J. Lindberg *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 163-171 (For primary document see N88-23872 17-27)
(Contract DEN3-27)
Avail: NTIS HC A11/MF A01 CSCL 14D

The thermal cyclic durability of commercial ceramic materials for turbine engines was under evaluation since 1978. Ceramic materials are exposed to cyclic diesel-fired burner exhaust at either 1204 or 1371 C (2200 or 2500 F) for up to 3500 hours. The test conditions are selected to simulate the environment experienced by the hot flow path components in an automotive gas turbine engine. The silicon nitride and silicon carbide materials tested are the same ceramic materials currently used on the AGT100 and AGT101 ceramic turbine engine program. Author

N88-23887*# Washington Univ., Seattle. Dept. of Materials Science and Engineering.
FRACTOGRAPHIC AND MICROSTRUCTURAL EVALUATION OF 3500-HOUR DURABILITY SPECIMENS c38
A. D. Miller *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 173-179 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 14D

Long term durability testing of candidate ceramic materials for advanced gas turbine applications was performed. Specimens of the materials were exposed to combustion atmospheres under temperature cyclic conditions for times up to 3500 hours and at peak temperatures of 1200 and 1370 C. The specimen strengths after exposure were measured at room temperature and at 1200 C. In addition, a number of physical measurements were taken; however, no microstructural examination of the specimens was performed. Materials examined include: sintered alpha silicon carbide, sintered silicon nitride, and reaction bonded silicon nitride. Sample preparation techniques were developed to provide high quality thin-section specimens which can be examined by transmitted light or thinned using an ion mill for subsequent transmission electron microscopic examination. Specimen preparation techniques and the results of optical and electron microscopic examination of the reaction interfaces of the selected specimens are presented. Author

N88-23888*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CERAMIC MATRIX COMPOSITES c24
James A. DiCarlo *In its* Structural Ceramics May 1986 p 181-187 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11D

An overview is presented covering NASA Lewis research efforts aimed at materials and processing development for structurally reliable fiber-reinforced ceramic matrix composites (FRC). With the primary goal of developing technology for strong, tough Si-based FRC with use-temperatures above 1400 C, guidelines for optimum material properties and current problems in achieving these properties are discussed. Brief descriptions of particular research

projects directed toward solving these problems are presented. Particular emphasis is placed on those efforts addressing the critical need of developing high performance SiC fibers with stability above 1400 C and with proper coatings for optimum composite structural performance. Based on current results for fiber and matrix development, concluding remarks are made concerning future directions of FRC studies. Author

N88-23889*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Macromolecular Science.
POLYMER PRECURSORS FOR SIC CERAMIC MATERIALS
Morton H. Litt *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 189-197 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11C

Work on precursor polymers to SiC was performed, concentrating on polymers made from decamethyl cyclohexasilyene units. The initial approach was to synthesize mixed diphenyl decamethyl cyclohexasilane, dephenylate, and polymerize. This produced polymers which had yields of up to 50 percent SiC. (Theoretical yield is 75 percent). The present approach is to make the polymer through the intermediate trans-1,4-diphenyl decamethyl cyclohexasilane. This should produce a crystalline polymer and high strength fibers. These will be thermally decomposed to SiC fibers. This requires new chemistry which is currently being studied. Author

N88-23890*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POLYMER PRECURSORS FOR CERAMIC COMPOSITES c24
Frances I. Hurwitz *In its* Structural Ceramics May 1986 p 199-202 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11D

The fiber composite approach to reinforced ceramics provides the possibility of achieving ceramics with high fracture toughness relative to monolithics. Fabrication of ceramic composites, however, demands low processing temperatures to avoid fiber degradation. Formation of complex shapes further requires small diameter fibers as well as techniques for infiltrating the matrix between fibers. Polymers offer low temperature processability, control of rheology not available with ceramic powders, and should serve as precursors to matrix fibers. In recent years, a number of polysilanes and polysilezanes were investigated as potential presursors. A review of candidate polymers is presented, including recent studies of silsesquioxanes. Author

N88-23891*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIC FIBER ANALYSIS
Martha H. Jaskowiak *In its* Structural Ceramics May 1986 p 203-212 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11C

Polymer derived Nicalon SiC fibers are known to be thermally unstable at temperatures beyond 1200 C. In an effort to further understand the mechanisms of fiber degradation, Nicalon fibers were heat treated at temperatures up to 2200 C and argon gas pressures varying from 0 to 1360 atm. The effects of gas pressure on the thermal stability of the fibers were determined through property comparisons between the pressure-treated fibers and vacuum-treated fibers. Investigation of the thermal stability included studies of the fiber microstructure and mechanical and physical properties before and after treatments. Author

N88-23892*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIC FIBER REINFORCED REACTION-BONDED SI3N4 COMPOSITES c24
Ramakrishna T. Bhatt *In its* Structural Ceramics May 1986 p 213-222 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 11D

A technique for fabricating strong and tough SiC fiber reinforced reaction bonded Si3N4 matrix composites (SiC/RBSN) was developed. Using this technique, composites containing approximately 23, 30, and 40 volume fractions of aligned 140 micron diameter, chemically vapor deposited SiC fibers were fabricated. The room temperature physical and mechanical properties were evaluated. The results for composite tensile strength, bend strength, and fracture strain indicate that the composite displays excellent properties when compared with the unreinforced matrix of comparable porosity. The composite stress at which the matrix first cracks and the ultimate composite fracture strength increase with increasing volume fraction of fibers, and the composite fails gracefully. The mechanical property data of this ceramic composite are compared with similar data for unreinforced commercially available Si3N4 materials and for SEP SiC/SiC composites. Author

N88-23893*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPOSITIONAL REDISTRIBUTION DURING CASTING OF Hg SUB 0.8 Cd SUB 0.2 Te ALLOYS
Ching-Hua Su, G. L. E. Perry, F. R. Szofran, and S. L. Lehoczky [1986] 21 p Submitted for publication
(NASA-TM-101151; NAS 1.15:101151) Avail: NTIS HC A03/MF A01 CSCL 11B

A series of Hg(0.8)Cd(0.2)Te ingots was cast both vertically and horizontally under well-defined thermal conditions by using a two-zone furnace with isothermal heat-pipe liners. The main objective of the experiments was to establish correlations between casting parameters and compositional redistribution and to develop ground-based data for a proposed flight experiment of casting of Hg(1-x)Cd(x)Te alloys under reduced gravity conditions. The compositional variations along the axial and radial directions were determined by precision density measurements, infrared transmission spectra, and X-ray energy dispersion spectrometry. Comparison between the experimental results and a numerical simulation of the solidification process of Hg(0.8)Cd(0.2)Te is described. Author

N88-23894* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CELLULAR THERMOSETTING FLUOROPOLYMERS AND PROCESS FOR MAKING THEM Patent
Sheng Y. Lee 15 Mar. 1988 5 p Filed 29 May 1986
Supersedes N86-32570 (24 - 24, p 3710)
(NASA-Case-GSC-13008-1; US-Patent-4,731,211; US-Patent-Appl-SN-867987; US-Patent-Class-264-50; US-Patent-Class-264-DIG.64; US-Patent-Class-425-4-R) Avail: US Patent and Trademark Office CSCL 11B

Thermosetting fluoropolymer foams are made by mixing fluid from thermosetting fluoropolymer components having a substantial fluoride content, placing the mixture in a pressure tight chamber, filling the chamber with a gas, at a relatively low pressure, that is unreactive with the fluoropolymer components, allowing the mixture to gel, removing the gelled fluoropolymer from the chamber and therafter heating the fluoropolymer at a relatively low temperature to simultaneously cure and foam the fluoropolymer. The resulting fluoropolymer product is closed celled with the cells storing the gas employed for foaming. The fluoropolymer resins employed may be any thermosetting fluoropolymer including fluoroepoxies, fluoropolyurethanes and fluoroacrylates.
Official Gazette of the U.S. Patent and Trademark Office

N88-23851# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
DEVELOPMENT OF MICROENCAPSULATED DNBM QUATERNARY AMMONIUM INHIBITORS FOR PAINTS
Lionel J. Bailin and Vinod S. Agarwala (Naval Air Development Center, Warminster, Pa.) *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 111-127 (For primary document see N88-23847 17-26)
(Contract N62269-85-C-0218)
Avail: NTIS HC A20/MF A01 CSCL 11B

N88-23858# Sermatech International, Inc., Limerick, Pa.
RECENT ADVANCES IN METALLIC/CERAMIC COATINGS FOR CORROSION CONTROL IN MILITARY APPLICATIONS
Mark F. Mosser *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 259-279 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11B

N88-23859# Lehigh Univ., Bethlehem, Pa. Dept. of Chemistry.
CARBOXYLATE FORMATION AT THE INTERFACE BETWEEN A POLYIMIDE COATING AND COBALT
Richard D. Cranata, Philip D. Deck, and Henry Leidheiser, Jr. *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 280-302 Sponsored by ONR, Washington, D.C. (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 11B

N88-23862# Minnesota Mining and Mfg. Co., St. Paul. Adhesives, Coatings and Sealers Div.
WATER BASED PRIMERS FOR STRUCTURAL ADHESIVE BONDING OF AIRCRAFT
A. V. Pocius and T. H. Wilson, Jr. *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 343-358 Previously announced in IAA as A88-32992 (For primary document see N88-23847 17-26)
(Contract F33615-86-R-5009)
Avail: NTIS HC A20/MF A01 CSCL 11B

N88-24281# Oak Ridge National Lab., Tenn.
HIGH-TEMPERATURE THERMAL CONDUCTIVITY OF A CARBON-BONDED CARBON-FIBER INSULATION
R. E. Pawel, W. P. Eatherly, J. M. Robbins, and D. L. McElroy *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 111-114 Previously announced as N87-18621 (For primary document see N88-24254 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A22/MF A01

N88-24318# General Electric Co., Philadelphia, Pa.
ANALYSIS OF THERMAL AND RADIATION EFFECTS IN MATERIALS USING THE GEMAT PROCESS
C. P. Dulka, H. Aswathanarayana, and J. F. Scamman *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 269-274 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24449# Rasor Associates, Inc., Sunnyvale, Calif.
RESEARCH AND DEVELOPMENT OF ELECTRICAL INSULATORS FOR THERMIONIC APPLICATIONS
Jesse C. Dobson, Frank W. Clinard, Jr., and Larry D. Woolf (GA Technologies, Inc., San Diego, Calif.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 365-368 (For primary document see N88-24374 17-73)
(Contracts DE-AC03-87SF-17169; DE-AC03-86SF-16298; W-7405-eng-36)
Avail: NTIS HC A99/MF A01

N88-24459# General Electric Co., Philadelphia, Pa. Astro Space Div.
CERAMIC ELECTRICAL INSULATOR DEVELOPMENT FOR THERMOELECTRIC SACE POWER SYSTEM Abstract Only
Solomon Musikant *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 417 (For primary document see N88-24374 17-73)
(Contract DE-AC03-86SF-16006)
Avail: NTIS HC A99/MF A01

N88-24460# General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
APPARATUS FOR THE MEASUREMENT OF RESISTIVITY OF GLASSES AND CERAMICS
Jack Hanson and Kenneth Bleiler *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 419-421 (For primary document see N88-24374 17-73)
(Contract DE-AC03-86SF-16006)
Avail: NTIS HC A99/MF A01

N88-24461# Sandia National Labs., Albuquerque, N. Mex.
SILICON-ON-INSULATOR ELECTRONICS FOR A SPACE NUCLEAR POWER SYSTEM
Daniel M. Fleetwood and Sylvia S. Tsao *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 423-426 (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N88-24444# Air Force Astronautics Lab., Edwards AFB, Calif.
NONCRYOGENIC PROPELLANTS FOR A NUCLEAR ORBIT TRANSFER VEHICLE
Ryan K. Haaland and Andrew Martin *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 341-344 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24483# Texas A&M Univ., College Station. Advanced Nuclear Fuels Lab.
MATERIAL PROPERTY AND IRRADIATION PERFORMANCE CORRELATIONS FOR NITRIDE FUELS
J. Kelly Thomas, Dan E. Brozak, Steven L. Hayes, and K. Lee Peddicord *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 535-541 (For primary document see N88-24374 17-73)
(Contracts DE-AC02-86NE-37960; LANL-9-X6D-1878G-1; LANL-9-X6D-1879G-1)
Avail: NTIS HC A99/MF A01

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N88-23895*# National Aeronautics and Space Administration, Washington, D.C.
NONCONTACT TEMPERATURE MEASUREMENT
Mark C. Lee, ed. Mar. 1988 429 p Workshop held in Washington, D.C., 30 Apr. - 1 May 1987
(NASA-CP-2503; NAS 1.55:2503) Avail: NTIS HC A19/MF A01 CSCL 12A

Noncontact temperature measurement has been identified as one of the eight advanced technology development (ATD) areas to support the effort of the Microgravity Science and Applications Division in developing six Space Station flight experiment facilities. This two-day workshop was an opportunity for all six disciplines to present their requirements on noncontact temperature measurement and to discuss state-of-the-art developments. Multi-color pyrometry, laser pyrometry and radiometric imaging

techniques are addressed. For individual titles, see N88-23896 through N88-23915.

N88-23896*# Wisconsin Univ., Madison. Instrumentation Systems Center.
RADIATION THERMOMETRY: THE MEASUREMENT PROBLEM c35
G. D. Nutter *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 3-63 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 14B

An overview of the theory and techniques of radiometric thermometry is presented. The characteristics of thermal radiators (targets) are discussed along with surface roughness and oxidation effects, fresnel reflection and subsurface effects in dielectrics. The effects of the optical medium between the radiating target and the radiation thermometer are characterized including atmospheric effects, ambient temperature and dust environment effects and the influence of measurement windows. The optical and photodetection components of radiation thermometers are described and techniques for the correction of emissivity effects are addressed. M.G.

N88-23897*# National Bureau of Standards, Washington, D.C. Center for Radiance Research.
THE NBS SCALE OF RADIANCE TEMPERATURE Abstract Only c35
William R. Waters, James H. Walker, and Albert T. Hattenburg *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 64 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 14B

The measurement methods and instrumentation used in the realization and transfer of the International Practical Temperature Scale (IPTS-68) above the temperature of freezing gold are described. The determination of the ratios of spectral radiance of tungsten-strip lamps to a gold-point blackbody at a wavelength of 654.6 nm is detailed. The response linearity, spectral responsivity, scattering error, and polarization properties of the instrumentation are described. The analysis of the sources of error and estimates of uncertainty are presented. The assigned uncertainties (three standard deviations) in radiance temperature range from + or - 2 K at 2573 K to + or - 0.5 K at 1073 K. Author

N88-23898*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NON-CONTACT TEMPERATURE MEASUREMENT REQUIREMENTS FOR ELECTRONIC MATERIALS PROCESSING c39
S. L. Lehoczky and F. R. Szofran *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 67-78 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

The requirements for non-contact temperature measurement capabilities for electronic materials processing in space are assessed. Non-contact methods are probably incapable of sufficient accuracy for the actual absolute measurement of temperatures in most such applications but would be useful for imaging in some applications. Author

N88-23899*# Wisconsin Univ., Madison. Dept. of Metallurgical and Mineral Engineering.
NONCONTACT TEMPERATURE MEASUREMENT: REQUIREMENTS AND APPLICATIONS FOR METALS AND ALLOYS RESEARCH
J. H. Perepezko *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 79-106 (For primary document see N88-23895 17-29)
(Grant NAG3-436)
Avail: NTIS HC A19/MF A01 CSCL 22A

Temperature measurement is an essential capability for almost all areas of metals and alloys research. In the microgravity environment many of the science priorities that have been identified for metals and alloys also require noncontact temperature measurement capability. For example, in order to exploit the full potential of containerless processing, it is critical to have available a suitable noncontact temperature measurement system. This system is needed to track continuously the thermal history, including melt undercooling and rapid recalescence, of relatively small metal spheres during free-fall motion in drop tube systems. During containerless processing with levitation-based equipment, accurate noncontact temperature measurement is required to monitor one or more quasi-static samples with sufficient spatial and thermal resolution to follow the progress of solidification fronts originating in undercooled melts. In crystal growth, thermal migration, coarsening and other experiments high resolution thermal maps would be a valuable asset in the understanding and modeling of solidification processes, fluid flows and microstructure development. The science and applications requirements place several constraints on the spatial resolution, response time and accuracy of suitable instrumentation. Author

N88-23900*# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Materials Engineering.
NONCONTACT TEMPERATURE MEASUREMENT IN GLASS AND OTHER TRANSPARENT MATERIALS
Robert H. Doremus *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 107-114 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

The relationship between the optical properties of glass and temperature measurements in it by radiation pyrometry are described. Equations for the calculation of emissivity are presented and the transmittance, surface reflection and absorption characteristics of glass are defined. Recommendations are given regarding the selection of pyrometer wavelength sensitivity and the use of a blackbody radiator. Author

N88-23901*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONCONTACT TEMPERATURE MEASUREMENTS IN THE MICROGRAVITY FLUIDS AND TRANSPORT PHENOMENA DISCIPLINE
Jack Salzman *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 115-122 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

The program of activities within the Microgravity Fluids and Transport Phenomena Discipline has been structured to enable the systematic pursuit of an increased understanding of low gravity fluid behavior/phenomena in a way which ensures that the results are appropriate to the widest range of applications. This structure is discussed and an overview of some of the activities which are underway is given. Of significance is the fact that in the majority of the current and planned activities, the measurement and, or control of the fluid temperature is a key experiment requirement. In addition, many of the experiments require that the temperature measurement be nonintrusive. A description of these requirements together with the current techniques which are being employed or under study to make these measurements is also discussed. Author

N88-23902*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MICROGRAVITY COMBUSTION DISCIPLINE WORKING GROUP SUMMARY OF REQUIREMENTS FOR NONCONTACT TEMPERATURE MEASUREMENTS
Kurt Sacksteder *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 123-128 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

Current efforts of the Microgravity Combustion Working Group are summarized and the temperature measurement requirements for the combustion studies are defined. Many of the combustion systems that are studied in the low gravity environment are near-limit systems, that is, systems that are acting near the limit

of flammability in terms of oxygen concentration or fuel concentration. Systems of this type are normally weak in the sense that there is a delicate balance between the heat released in the flame and the heat required to sustain the flame. Intrusive or perturbative temperature measurement probes can be inaccurate in these situations and in the limiting case extinguish the flame. Noncontact techniques then become the only way to obtain the required measurements. Noncontact measurement requirements for each of the three thermodynamic phases are described in terms of spatial and temporal resolution and temperature range. Author

N88-23903*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
REQUIREMENTS FOR TEMPERATURE AND SPECIES CONCENTRATION MEASUREMENTS IN MICROGRAVITY COMBUSTION EXPERIMENTS
Paul D. Ronney *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 129-138 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

The requirements for a nonintrusive optical diagnostic facility for Space Station are assessed by examining the needs of current and future combustion experiments to be flown aboard the Space Station. Requirements for test section geometry and size, spatial and temporal resolution, species type and concentration range, and temperature range are reviewed. The feasibility of the development of this system is also addressed. The suitability of this facility to non-combustion experiments in gases and liquids is also considered. Author

N88-23904*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NON-CONTACT TEMPERATURE MEASUREMENTS FOR BIOTECHNOLOGY DISCIPLINE WORKING GROUP
Robert S. Snyder *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 139-142 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

In the biotechnology research areas, there is interest in measuring temperature changes over very small dimensions, such as the surface of a 10-micrometer diameter biological cell immersed in cell culture fluid. Non-interference measurements of other properties, such as chemical constituents and their concentrations, are also needed. Contacting probes for pH have recently been developed to penetrate a cell but questions have been raised about their accuracy and net value. Author

N88-23905*# Physical Sciences, Inc., Andover, Mass.
MULTI-COLOR PYROMETER FOR MATERIALS PROCESSING IN SPACE
Michael B. Frish, Mark N. Spencer, Nancy E. Wolk, Jennifer S. Werner, and Henry A. Miranda, Jr. (Miranda Labs., Bedford, Mass.) *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 145-172 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

The design, construction and calibration of a computer-linked multicolor pyrometer is described. The device was constructed for ready adaptation to a spacecraft and for use in the control of thermal processes for manufacturing materials in space. The pyrometer actually uses only one color at a time, and is relatively insensitive to uncertainties in the heated object's emissivity because the product of the color and the temperature has been selected to be within a regime where the radiant energy emitted from the body increases very rapidly with temperature. The instrument was calibrated and shown to exceed its design goal of temperature measurements between 300 and 2000 C, and its accuracy in the face of imprecise knowledge of the hot object's emissivity was demonstrated. Author

N88-23906*# Midwest Research Inst., Kansas City, Mo.
DIRECT EMISSIVITY MEASUREMENTS ON LIQUIDS AND CORRECTIONS TO MULTI-COLOR PYROMETERS
Paul C. Nordine and Robert A. Schiffman *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 173-181 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

Optical pyrometry provides a means for non-contact temperature measurements whose accuracy depends on the accuracy with which specimen emittance is known. Two methods for obtaining the required emittance data are discussed in which the emittance is determined from measurements of the wavelength or polarization dependence of light emitted by the specimen. The spectral technique, multi-color pyrometry, yields apparent values for specimen emittance and temperature from emitted intensity measurements at two or more wavelengths. Emittance corrections cannot be eliminated by increasing the number of spectral intensity measurements required by an n-color pyrometer. Even if this were possible, the accuracy of temperature measurements by n-color pyrometry decreases with n such that pyrometers that require four intensity measurements would be impractical. In contrast, emittance values and corrections for one-color pyrometers can be accurately measured by the polarized light technique. The polarized light technique involves measurement of the degree of polarization for light emitted at an angle of 45 deg to the specimen normal. The reflectivities (r) for light polarized parallel (p) and normal (n) to the plane of emission are related by $r(p) = r(n)$ squared. This leads to a simple relation between the intensity ratio for light emitted in the two polarized states and the emittance, i.e., $e(n) = 2 - I(p)/I(n)$. The true specimen temperature is also obtained if absolute intensities are measured. Delvelopment of the polarized light technique in combination with one-color optical pyrometry is recommended to achieve accurate non-contact temperature measurements on liquids. Author

N88-23907*# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
COMMON BUT UNAPPRECIATED SOURCES OF ERROR IN ONE, TWO, AND MULTIPLE-COLOR PYROMETRY
R. Erik Spjut *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 182-213 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

The most common sources of error in optical pyrometry are examined. They can be classified as either noise and uncertainty errors, stray radiation errors, or speed-of-response errors. Through judicious choice of detectors and optical wavelengths the effect of noise errors can be minimized, but one should strive to determine as many of the system properties as possible. Careful consideration of the optical-collection system can minimize stray radiation errors. Careful consideration must also be given to the slowest elements in a pyrometer when measuring rapid phenomena. Author

N88-23908*# National Bureau of Standards, Gaithersburg, Md. Thermophysics Div.
FAST OPTICAL PYROMETRY
Ared Cezairliyan *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 214-232 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

Design and operation of accurate millisecond and microsecond resolution optical pyrometers developed at the National Bureau of Standards during the last two decades are described. Results of tests are presented and estimates of uncertainties in temperature measurements are given. Calibration methods are discussed and examples of applications of fast pyrometry are given. Ongoing research in developing fast multiwavelength and spatial scanning pyrometers are summarized. Author

N88-23909*# Vanzetti Systems, Inc., Stoughton, Mass.
THE ROLE OF FIBEROPTICS IN REMOTE TEMPERATURE MEASUREMENT
Riccardo Vanzetti *In* NASA, Washington, D.C. Noncontact

Temperature Measurement Mar. 1988 p 233-275 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

The use of optical fibers in conjunction with infrared detectors and signal processing electronics represents the latest advance in the field of non-contact temperature measurement and control. The operating principles and design of fiber-optic radiometric systems are discussed and the advantages and disadvantages of using optical fibers are addressed. Signal processing requirements and various infrared detector types are also described. Several areas in which infrared fiber-optic instrumentation is used for temperature monitoring and control are discussed. Author

N88-23910*# Quantum Logic Corp., Oakland, N.J.
LASER PYROMETRY
Alexander Stein *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 279-290 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

A method of determining the emissivity of a hot target from a laser-based reflectance measurement which is conducted simultaneously with a measurement of the target radiance is described. Once the correct radiance and emissivity are determined, one calculates the true target temperature from these parameters via the Planck equations. The design and performance of a laser pyrometer is described. The accuracy of laser pyrometry and the effect of ambient radiance are addressed. Author

N88-23911*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NONCONTACT TRUE TEMPERATURE MEASUREMENT, 2
Mark C. Lee and James L. Allen *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 291-304 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

A laser pyrometer was developed for acquiring the true temperature of a levitated sample. The reflectivity is measured by first expanding the laser beam to cover the entire cross-sectional surface of the diffuse target. The reflectivity calibration of this system is determined from the surface emissivity of a target with a blackbody cavity. The emissivity of the real target can then be calculated. The overall system constant is obtained by passively measuring the radiance of the blackbody cavity (emissivity = 1.0) at a known, arbitrary temperature. Since the photosensor used is highly linear over the entire operating temperature range, the true temperature of the target can then be computed. The latest results available from this on-going research indicate that true temperatures thus obtained are in very good quantitative agreement with thermocouple measured temperatures. Author

N88-23912*# United Technologies Research Center, East Hartford, Conn.
LASER DIAGNOSTICS FOR COMBUSTION TEMPERATURE AND SPECIES MEASUREMENTS
Alan C. Eckbreth *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 305-364 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

Laser optical diagnostic techniques for the measurement of combustion gaseous-phase temperatures and, or species concentrations are discussed. The techniques fall into two classes: incoherent (Rayleigh scattering, spontaneous Raman scattering, laser induced fluorescence spectroscopy) and coherent (coherent anti-Stokes Raman spectroscopy). The advantages, disadvantages and applicability of each method are outlined. Author

N88-23913*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INFRARED RADIOMETRIC TECHNIQUE IN TEMPERATURE MEASUREMENT
S. Glazer and R. Madding (Inframetrics, Inc., Bedford, Mass.) *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 367-383 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

One class of commercially available imaging infrared radiometers using cooled detectors is sensitive to radiation over the 3 to 12 micron wavelength band. Spectral filters can tailor instrument sensitivity to specific regions where the target exhibits optimum radiance. The broadband spectral response coupled with real time two-dimensional imaging and emittance/background temperature corrections make the instruments useful for remote measurement of surface temperatures from -20 C to +1500 C. Commonly used radiometric techniques and assumptions are discussed, and performance specifications for a typical modern commercial instrument are presented. The potential usefulness of an imaging infrared radiometer in space laboratories is highlighted through examples of research, nondestructive evaluation, safety, and routine maintenance applications. Future improvements in instrument design and application of the radiometric technique are discussed. Author

N88-23914*# Massachusetts Inst. of Tech., Cambridge.
REAL TIME THERMAL IMAGING OF HIGH TEMPERATURE SEMICONDUCTOR MELTS
Michael J. Wargo *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 384-404 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

A real time thermal imaging system with temperature resolution better than + or - 1 C and spatial resolution of better than 0.5 mm was developed and applied to the analysis of melt surface thermal field distributions in both Czochralski and liquid encapsulated Czochralski (LEC) growth configurations. The melt is viewed in near normal incidence by a high resolution charge coupled device camera to which is attached a very narrow bandpass filter. The resulting image is digitized and processed using a pipelined pixel processor operating at an effective 40 million operations per second thus permitting real time high frequency spatial and temporal filtering of the high temperature scene. A multi-pixel averaging algorithm was developed which permits localized, low noise sensing of temperature variations at any location in the hot zone as a function of time. This signial is used to implement initial elements of a feedforward growth control scheme which is aimed at reducing disturbances to the melt caused by the batch nature of the growth process. The effect of magnetic melt stabilization on radial melt temperature distributions was measured using this technique. Problems associated with residual internal reflections and non-optimized path geometry are discussed. Author

N88-23915*# State Univ. of New York, Buffalo. Dept. of Biophysical Sciences.
CLINICAL APPLICATIONS OF COMPUTERIZED THERMOGRAPHY
Michael Anbar *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 405-414 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

Computerized or digital, thermography is a rapidly growing diagnostic imaging modality. It has superseded contact thermography and analog imaging thermography which do not allow effective quantization. Medical applications of digital thermography can be classified in two groups: static and dynamic imaging. They can also be classified into macro thermography (resolution greater than 1 mm) and micro thermography (resolution less than 100 microns). Both modalities allow a thermal resolution of 0.1 C. The diagnostic power of images produced by any of these modalities can be augmented by the use of digital image enhancement and image recognition procedures. Computerized thermography has been applied in neurology, cardiovascular and plastic surgery, rehabilitation and sports medicine, psychiatry, dermatology and ophthalmology. Examples of these applications are shown and their scope and limitations are discussed. Author

N88-23916*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SEPARATION OF BIOLOGICAL MATERIALS IN MICROGRAVITY
D. E. Brooks, J. Boyce, S. B. Bamberger, J. M. VanAlstine, and J. M. Harris (Alabama Univ., Huntsville.) [1986] 15 p Submitted for publication
(NASA-TM-101142; NAS 1.15:101142) Avail: NTIS HC A03/MF A01 CSCL 22A

Partition in aqueous two phase polymer systems is a potentially useful procedure in downstream processing of both molecular and particulate biomaterials. The potential efficiency of the process for particle and cell isolations is much higher than the useful levels already achieved. Space provides a unique environment in which to test the hypothesis that convection and settling phenomena degrade the performance of the partition process. The initial space experiment in a series of tests of this hypothesis is described. Author

N88-24139# Sira Inst. Ltd., Chislehurst (England). Research and Development Div.
BOTANY FACILITY: CONSIDERATIONS AND ANALYSES OF THE BALANCING SYSTEM PHILOSOPHY PROPOSED FOR THE BF CENTRIFUGE
P. J. W. Ford *In* MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 39 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP110/PWF001) Copyright Avail: NTIS HC A17/MF A01

N88-24140# Sira Inst. Ltd., Chislehurst (England).
BOTANY FACILITY: THE PROBLEMS OF PLANT FIXATION
In MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 10 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP220/RJS/001) Copyright Avail: NTIS HC A17/MF A01

N88-24322# Oak Ridge National Lab., Tenn.
AN EXPERIMENT TO INVESTIGATE RANKINE CYCLE TWO-PHASE MICROGRAVITY ISSUES
G. L. Yoder and E. D. Brewer *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 289-292 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24335# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF SWIRL FLOW PHASE SEPARATORS FOR MICROGRAVITY APPLICATIONS
Vladimir Valentekovich, Daniel J. Pafford, and Vijay K. Dhir *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 347-350 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24439# Oregon State Univ., Corvallis. Dept. of Nuclear Engineering.
MICROGRAVITY THAW EXPERIMENT (MITEX)
Andrew C. Klein, Kean G. Stump, Gene Wallis, William J. Krotiuk, and Brent J. Webb (Battelle Pacific Northwest Labs., Richland, Wash.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 321-324 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24464*# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering and Applied Mechanics.
NUCLEATE POOL BOILING: HIGH GRAVITY TO REDUCED GRAVITY; LIQUID METALS TO CRYOGENS
Herman Merte, Jr. *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 437-442 (For primary document see N88-24374 17-73)
(Contract NAS8-20228; Grants NAG3-633; NAG3-589)
Avail: NTIS HC A99/MF A01 CSCL 22A

N88-24465*# Pacific Northwest Labs., Richland, Wash.
REDUCED-GRAVITY TWO-PHASE FLOW EXPERIMENTS IN THE NASA KC-135
Judith M. Cuta, Thomas E. Michener, Frederick R. Best, and Leo J. Kachnik (Texas A&M Univ., College Station.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 443-446 Sponsored by NASA, Washington, D.C., DOE, Washington, D.C. and Wright-Patterson AFB, Ohio (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 22A

N88-24466*# Pacific Northwest Labs., Richland, Wash.
ANALYSIS AND INTERPRETATION OF LOW GRAVITY BOILING EXPERIMENTS IN THE KC-135
Judith M. Cuta, William J. Krotiuk, and Jeffery W. Samuels (Oregon State Univ., Corvallis.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 447-450 Sponsored by NASA, Washington, D.C., DOE, Washington, D.C. and Northwest Coll. and University Association for Science (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 22A

N88-24467*# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
MICROGRAVITY TWO-PHASE FLUID FLOW PATTERN MODELING
Doojeong Lee and Frederick R. Best *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 451-455 Sponsored by NASA, Lyndon B. Johnson Space Center, Houston, Tex. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 22A

N88-24470# Kentucky Univ., Lexington. Dept. of Mechanical Engineering.
LOW GRAVITY THERMAL MANAGEMENT USING DIELECTROPHORETIC FORCES
Jay H. Ambrose, Louis C. Chow, Donald E. Tilton, and Tom Mahefkey (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 465-468 Sponsored in part by AFOSR, Bolling AFB, Washington, D.C. and AFAPL, Wright-Patterson AFB, Ohio (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N88-23917*# National Aeronautics and Space Administration. Pasadena Office, Calif.
KRYPTON BASED ADSORPTION TYPE CRYOGENIC REFRIGERATOR Patent Application
Jack A. Jones, inventor (to NASA) and Helene Schember, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 1 Dec. 1987 26 p
(Contract NAS7-918)
(NASA-Case-NPO-17334-1-CU; NAS 1.71:NPO-17334-1-CU; US-Patent-Appl-SN-149821) Avail: NTIS HC A03/MF A01 CSCL 13B

Krypton and monolithic porous carbon such as Saran carbon are used respectively as the sorbate and sorbent of an absorption type refrigerator to improve refrigeration efficiency and operational longevity. NASA

N88-23918*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PARAMETER ESTIMATION FOR BOUNDARY VALUE PROBLEMS BY INTEGRAL EQUATIONS OF THE SECOND KIND
Fumio Kojima Apr. 1988 41 p
(Contract NAS1-18107)
(NASA-CR-181660; ICASE-88-28; NAS 1.26:181660) Avail: NTIS HC A03/MF A01 CSCL 13B

This paper is concerned with the parameter estimation for boundary integral equations of the second kind. The parameter estimation technique through use of the spline collocation method is proposed. Based on the compactness assumption imposed on the parameter space, the convergence analysis for the numerical method of parameter estimation is discussed. The results obtained here are applied to a boundary parameter estimation for 2-D elliptic systems. Author

N88-23919*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ENVIRONMENTAL PROJECTS. VOLUME 6: ENVIRONMENTAL ASSESSMENT. NEW 34-METER ANTENNA AT VENUS SITE
L. Kushner 15 Jun. 1988 80 p
(Contract NAS7-918)
(NASA-CR-182922; JPL-Publ-87-4; NAS 1.26:182922) Avail: NTIS HC A05/MF A01 CSCL 13B

The Jet Propulsion Lab has proposed replacing the 26-meter antenna at the Venus Station of the Goldstone Deep Space Communications Complex with a new 34-meter antenna. An environmental impact assessment of this proposed change is presented. It is concluded that the proposed antenna and its operation would not result in significant adverse impacts to the physical or human environment. It will, however, be necessary to manage electromagnetic transmissions from the antenna in such a manner as to ensure safe operation. J.P.B.

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N88-23920# Columbia Univ., New York, N.Y.
RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM Progress Report No. 37, 1 Oct. 1986 - 30 Sep. 1987
George W. Flynn and Richard M. Osgood, Jr. 31 Dec. 1987 150 p
(Contracts DAAG29-85-K-0049; F49620-85-C-0210; F30602-85-C-0072; F49620-85-C-0067; DAAG29-85-K-0210; N00014-78-C-0154; N00014-78-C-0517; N00014-86-K-0694; DE-AC02-78ER-04940; Grant AF-AFOSR-00138-84)
(AD-A190198) Avail: NTIS HC A07/MF A01 CSCL 17E

The usual semiclassical theory of light detection has been demonstrated to be valid only in the absence of feedback from detector to source. A revised theory has been developed that is valid even in the presence of such feedback. Research has begun on the possibility of using various heterostructures (including quantum-well devices) that might serve as solid-state versions of the space-charge-limited Franck-Hertz experiment (this experiment produced the first source of CW photon-number-squeezed light, reported in 1985). GRA

N88-23921# Columbia Univ., New York, N.Y.
RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM, APPENDIX Progress Report No. 37, 1 Oct. 1986 - 30 Sep. 1987
George W. Flynn and Richard M. Osgood, Jr. 31 Dec. 1987 252 p
(Contract DAAG29-85-K-0049; F49620-85-C-0210)
(AD-A190199) Avail: NTIS HC A12/MF A01 CSCL 17E

The usual semiclassical theory of light detection has been demonstrated to be valid only in the absence of feedback from detector to source. A revised theory has been developed that is valid even in the presence of such feedback. Research has begun on the possibility of using various heterostructures (including quantum-well devices) that might serve as solid-state versions of the space-charge-limited Franck-Hertz experiment. This report is a compilation of many papers related to the following fields: photon-number-squeezed light, theory of light detection, excess noise factor, feedback, sub-Poisson light, superlattice avalanche photodiodes, ions, low energy ion beam, gallium arsenide MESFET, deuterium, infrared absorption, pyruvic acid, photodissociation, femtosecond, binaphthyl, adsorption, ultrafast modulation spectroscopy, photoionic emission, germanium nitride, diode laser, energy transfer, isomerization. GRA

N88-23922*# Notre Dame Univ., Ind. Dept. of Electrical and Computer Engineering.
ERROR CONTROL TECHNIQUES FOR SATELLITE AND SPACE COMMUNICATIONS
Daniel J. Costello, Jr. Jun. 1988 140 p
(Grant NAG5-557)
(NASA-CR-182886; NAS 1.26:182886) Avail: NTIS HC A07/MF A01 CSCL 17B

During the period December 1, 1987 through May 31, 1988, progress was made in the following areas: construction of Multi-Dimensional Bandwidth Efficient Trellis Codes with MPSK modulation; performance analysis of Bandwidth Efficient Trellis Coded Modulation schemes; and performance analysis of Bandwidth Efficient Trellis Codes on Fading Channels. B.G.

N88-23923*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DOPPLER RADAR WITH MULTIPHASE MODULATION OF TRANSMITTED AND REFLECTED SIGNAL Patent Application
Paul W. Shores, inventor (to NASA), John W. Griffin, inventor (to NASA), and Hebert Kobayashi, inventor (to NASA) 25 Nov. 1987 16 p
(NASA-Case-MSC-18808-1; NAS 1.71:MSC-18808-1) Avail: NTIS HC A03/MF A01 CSCL 17I

A microwave radar signal is generated and split by a circulator. A phase shifter introduces a series of phase shifts into a first part of the split signal which is then transmitted by antenna. A like number of phase shifts is introduced by the phase shifter into the return signal from the target. The circulator delivers the phase shifted return signal and the leakage signal from the circulator to a mixer which generates an IF signal output at the Doppler frequency. The IF signal is amplified, filtered, counted per unit of time, and the result displayed to provide indications of target sense and range rate. An oscillator controls rate of phase shift in the transmitted and received radar signals and provides a time base for the counter. The phase shift magnitude increases may be continuous and linear or discrete functions of time. NASA

N88-23924*# National Aeronautics and Space Administration. Pasadena Office, Calif.
TELEVISION MONITOR FIELD SHIFTER AND AN OPTO-ELECTRONIC METHOD FOR OBTAINING A STEREO IMAGE OF OPTIMAL DEPTH RESOLUTION AND REDUCED DEPTH DISTROTION ON A SINGLE SCREEN Patent Application
Daniel B. Diner, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 25 Nov. 1987 40 p
(Contract NAS7-918)

(NASA-Case-NPO-17249-1-CU; NAS 1.71:NPO-17249-1-CU; US-Patent-Appl-SN-125666) Avail: NTIS HC A03/MF A01 CSCL 17B

A method and apparatus is developed for obtaining a stereo image with reduced depth distortion and optimum depth resolution. Static and dynamic depth distortion and depth resolution tradeoff is provided. Cameras obtaining the images for a stereo view are converged at a convergence point behind the object to be presented in the image, and the collection-surface-to-object distance, the camera separation distance, and the focal lengths of zoom lenses for the cameras are all increased. Doubling the distances cuts the static depth distortion in half while maintaining image size and depth resolution. Dynamic depth distortion is minimized by panning a stereo view-collecting camera system about a circle which passes through the convergence point and the camera's first nodal points. Horizontal field shifting of the television fields on a television monitor brings both the monitor and the stereo views within the viewer's limit of binocular fusion. NASA

N88-23925# Ecole Nationale Superieure des Telecommunications, Paris (France).

MODELING, FILTERING AND CONTROL OF STOCHASTIC PROCESSES Ph.D. Thesis [MODELISATION, FILTRAGE ET CONTROLE DE PROCESSUS STOCHASTIQUES]

Robert Cohen Nov. 1987 144 p In FRENCH

(ENST-87E021; ISSN-0751-1353; ETN-88-92180) Avail: NTIS HC A07/MF A01

A filtering formula for nonlinear systems having a continuous observation, and a discrete one at random times is presented. A solution to the partially observed control problem of linear systems, with nonquadratic cost is outlined. Stochastic continuous control of partially observed systems via impulse control problems is discussed. Modeling the error process in digital transmission is considered. ESA

N88-23926# Stuttgart Univ. (West Germany). Inst. of Navigation.

PREPARATION AND EXECUTION OF CALIBRATION MEASUREMENTS FOR HANDLING OF AIRBORNE SAR DATA (AGRISAR) Final Report, 31 Dec. 1986

Manfred Reich Bonn, Fed. Republic of Germany Bundesministerium fuer Forschung und Technologie Jul. 1987 82 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn, Fed. Republic of Germany

(ETN-88-92338) Avail: NTIS HC A05/MF A01

Calibration of X-band SAR image data by reference measurements using ground-based X-band scatterometer measurements from 10 test fields; comparison of these experiments with the calibration measurements carried out with corner reflectors and active radar calibrators; measurement of the SAR antenna diagram by measuring the field strength on ground is proposed. Methods include comparison of the X-Band scatterometer data with the gray level statistics of the corresponding test fields in the SAR image, to perform the radiometric calibration. Different sized reflectors and calibrators were deployed in the flight direction for the external calibration with point targets. Identifying the corresponding pixels and their gray values is the next step in the calibration procedure. Results include calibration curves, sigma 0 as a function of gray values, of the center of the radar swath, and production of the antenna diagram of the SAR antenna in azimuth direction. Applications include correction of multitemporal radar images, and detection of sidelobes of the SAR antenna diagram and estimating their influence. ESA

N88-23927# Royal Signals and Radar Establishment, Malvern (England).

EXPERIMENTS IN ISOLATED DIGIT RECOGNITION USING THE MULTILAYER PERCEPTRON

S. M. Peeling and R. K. Moore 17 Dec. 1987 47 p

(RSRE-Memo-4073; BR105252; ETN-88-92514) Copyright Avail: NTIS HC A03/MF A01

The multilayer perceptron is investigated as an approach to the automatic recognition of spoken isolated digits. The choice of the parameters of the multilayer perceptron is discussed and experimental results are reported. A comparison is made with established techniques such as dynamic time-warping and hidden Markov modelling applied to the same data. The results show that the recognition accuracy obtained using the multilayer perceptron is comparable with that using hidden Markov modelling. ESA

N88-23928# Royal Signals and Radar Establishment, Malvern (England).

EXPERIMENTAL EVALUATION OF ALGORITHMS FOR CONNECTED SPEECH RECOGNITION USING HIDDEN MARKOV MODELS

Anneliese Cook 1 Dec. 1987 24 p

(RSRE-Memo-4099; BR104991; ETN-88-92517) Copyright Avail: NTIS HC A03/MF A01

A method of extracting training utterances from fluent speech and constructing Hidden Markov Models (HMMs) from these templates, known as embedded training, is investigated with a two-level algorithm for connected word recognition. The effects on recognition performance of various HMM training procedures are discussed, and experimental results for native and non-native English speakers are presented. Training on isolated words does not produce models adequate for use in connected word recognition; whether the model was highly unconstrained, to allow for compression of the words in fluent speech, or had a tightly specified transition matrix, to discourage insertion errors, the results are disappointing. The embedded training procedure improves performance, if the Bakis model structure is used; if a full upper-triangular transition probability matrix is used, the performance is far worse than in the isolated-word training case. If the Baum-Welch algorithm is performed after the segmentation procedure, performance improves, but whether this improvement is sufficient to justify the increase in computer time required is questionable. ESA

N88-23929*# Houston Univ., Tex. Applied Electromagnetics Lab.

AN INVESTIGATION OF CONFORMABLE ANTENNAS FOR THE ASTRONAUT BACKPACK COMMUNICATION SYSTEM Final Report

Stuart A. Long, David R. Jackson, Jeffery T. Williams, and Donald R. Wilton 1 Jun. 1988 190 p

(Grant NAG9-219)

(NASA-CR-182908; NAS 1.26:182908; TR-88-18) Avail: NTIS HC A09/MF A01 CSCL 17B

During periods of extravehicular activity it is obviously important that communication and telemetry systems continue to function independently of the astronaut. A system of antennas must therefore be designed that will provide the necessary isotropic coverage using circular polarization over both the transmit and receive frequency bands. To avoid the inherent physical limitations to motion that would be incurred with any sort of protruding antenna, it is necessary that the radiator be essentially flush-mounted or conformable to the structure on which it is attached. Several individual antenna elements are needed for the desired coverage. Both the particular elements chosen and their location determine the ultimate radiation pattern of the overall system. For these reasons a two-fold research plan was undertaken. First, individual elements were investigated and designed. Then various mounting locations were considered and the radiation patterns were predicted taking into account the effects of the astronaut's backpack. Author

N88-23930 Illinois Univ., Chicago.

ELECTROMAGNETIC SCATTERING FROM NONLINEAR ANISOTROPIC CYLINDERS Ph.D. Thesis

Mohd A. Hasan 1987 253 p

Avail: Univ. Microfilms Order No. DA8728748

The solution of the electromagnetic scattering of obliquely incident plane waves from homogeneous, nonlinear anisotropic cylindrical structures is obtained. The medium of the scatterer is

characterized by Volterra-type integrals for the electric and magnetic flux density vectors D and B, respectively. For the particular case of nondispersive dielectric medium, the displacement vector D reduces to a Taylor series expansion near zero. The nonlinear problem is solved using two methods: the iteration methods and the perturbation method. The effect of nonlinearities on the field properties both inside and outside the scatterer, together with the effect on the radar cross-section, are investigated. A numerically efficient computer code is developed and tested on a variety of scattering media for solid and hollow cylindrical bodies. It is concluded that the two methods give identical results if the nonlinearity is small or if the characteristic dimension of the scatterer is small compared to the wavelength. The other important observation is that the results obtained using the iteration method diverge from the linear results, with distortion, faster than those obtained by the perturbation method.
Dissert. Abstr.

N88-23931*# Ohio State Univ., Columbus. ElectroScience Lab.
MANUAL FOR OBSCURATION CODE WITH SPACE STATION APPLICATIONS
R. J. Marhefka and L. Takacs May 1986 237 p
(Grant NsG-1498)
(NASA-CR-178099; NAS 1.26:178099; Rept-716199-7) Avail: NTIS HC A11/MF A01 CSCL 20N

The Obscuration Code, referred to as SHADOW, is a user-oriented computer code to determine the case shadow of an antenna in a complex environment onto the far zone sphere. The surrounding structure can be composed of multiple composite cone frustums and multiply sided flat plates. These structural pieces are ideal for modeling space station configurations. The means of describing the geometry input is compatible with the NEC-BASIC Scattering Code. In addition, an interactive mode of operation has been provided for DEC VAX computers. The first part of this document is a user's manual designed to give a description of the method used to obtain the shadow map, to provide an overall view of the operation of the computer code, to instruct a user in how to model structures, and to give examples of inputs and outputs. The second part is a code manual that details how to set up the interactive and non-interactive modes of the code and provides a listing and brief description of each of the subroutines.
Author

N88-23932*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE SHUTTLE IMAGING RADAR B (SIR-B) EXPERIMENT REPORT
Jo Bea Cimino, Benjamin Holt, and Annie Richardson 15 Mar. 1988 223 p
(Contract NAS7-918)
(NASA-CR-182923; NAS 1.26:182923; JPL-Publ-88-2) Avail: NTIS HC A10/MF A01 CSCL 17I

The primary objective of the SIR-B experiment was to acquire multiple-incidence-angle radar imagery of a variety of Earth's surfaces to better understand the effects of imaging geometry on radar backscatter. A complementary objective was to map extensive regions of particular interest. Under these broad objectives, many specific scientific experiments were defined by the 43 SIR-B Science Team members, including studies in the area of geology, vegetation, radar penetration, oceanography, image analysis, and calibration technique development. Approximately 20 percent of the planned digital data were collected, meeting 40 percent of the scientific objectives. This report is an overview of the SIR-B experiment and includes the science investigations, hardware design, mission scenario, mission operations, events of the actual missions, astronaut participation, data products (including auxiliary data), calibrations, and a summary of the actual coverage. Also included are several image samples.
Author

N88-23933*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MSAT-X: A TECHNICAL INTRODUCTION AND STATUS REPORT
Khaled Dessouky and Miles Sue 15 Apr. 1988 107 p
(Contract NAS7-918)
(NASA-CR-182921; JPL-Publ-88-12; NAS 1.26:182921; MSAT-X-Rept-148) Avail: NTIS HC A06/MF A01 CSCL 17B

A technical introduction and status report for the Mobile Satellite Experiment (MSAT-X) program is presented. The concepts of a Mobile Satellite System (MSS) and its unique challenges are introduced. MSAT-X's role and objectives are delineated with focus on its achievements. An outline of MSS design philosophy is followed by a presentation and analysis of the MSAT-X results, which are cast in a broader context of an MSS. The current phase of MSAT-X has focused notably on the ground segment of MSS. The accomplishments in the four critical technology areas of vehicle antennas, modem and mobile terminal design, speech coding, and networking are presented. A concise evolutionary trace is incorporated in each area to elucidate the rationale leading to the current design choices. The findings in the area of propagation channel modeling are also summarized and their impact on system design discussed. To facilitate the assessment of the MSAT-X results, technology and subsystem recommendations are also included and integrated with a quantitative first-generation MSS design.
Author

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N88-23934# Societe Anonyme de Telecommunications, Paris (France).
STUDY FOR THE DETERMINATION OF GENERAL AND SPECIFIC PROPERTIES OF WIDE ENERGY-BAND GAP HgCdTe IN THE 1 TO 2 MICROMETER WAVELENGTH RANGE Interim Report No. 2, Oct. - Dec. 1987
T. Nguyen, A. Durand, M. Royer, and F. Raymond 9 Jan. 1988 8 p
(Contract DAJA45-87-C-0020)
(AD-A191091) Avail: NTIS HC A02/MF A01 CSCL 09A

The second phase of this contract was dedicated to the optimization of the technical fabrication parameters of HgCdTe avalanche photodiodes in the 1.3 micron to 1.55 micron wavelength region. In addition, the electroluminescent properties and the technical feasibility of HgCdTe emitters were investigated. The fabrication technology implemented for the deliverable avalanche photodiodes under this contract is planar.
GRA

N88-23935# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
APPLICATION OF CHAOS THEORY TO 1/f NOISE
A. Fote, S. Kohn, E. Fletcher, and J. McDonough 12 Feb. 1988 50 p
(Contract F04701-85-C-0086)
(AD-A191150; SD-TR-88-29) Avail: NTIS HC A03/MF A01 CSCL 12I

1/f noise limits the sensitivity of HgCdTe photodiodes operated in the low frequency staring mode. Because other theories have failed to account for 1/f noise as a general phenomenon, the applicability of chaos theory in this material is investigated. 1/f noise data from HgCdTe photodiodes are applied to the analytic technique of R. Grassborger and I. Procaccia. Analysis indicates that a chaotic phenomenon underlies the 1/f noise. Construction of a model of 1/f noise in HgCdTe photodiodes consistent with the principle of chaos theory and the body of experimental

knowledge about this phenomenon is begun. Initial model produced a 1/f to the alpha power noise spectrum with alpha having a value close to 2. GRA

N88-23936*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MINIATURE TRAVELING WAVE TUBE AND METHOD OF MAKING Patent Application
Henry G. Kosmahl 8 Dec. 1987 15 p
(NASA-Case-LEW-14520-1; NAS 1.71:LEW-14520-1; US-Patent-Appl-SN-130058) Avail: NTIS H A03/MF A01 CSCL 09A

A miniature traveling wave tube is provided which will have most of the advantages of solid state circuitry but with higher efficiency and without being highly sensitive to temperature and various types of electromagnetic radiation and subatomic particles as are solid state devices. The traveling wave tube is about 2.5 cm in length and includes a slow wave circuit (SWS) comprised of apertured fins with a top cover which is insulated from the fins by strips or rungs of electrically insulating, dielectric material. An extemely small SWS is constructed by employing various grooving and etching methods, and by providing insulating strips or rungs by various deposition and masking techniques. NASA

N88-23937*# National Aeronautics and Space Administration. Pasadena Office, Calif.
LOW POWER CONSUMPTION CURRENT TRANSDUCER Patent Application
W. T. McLyman, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 15 Dec. 1976 14 p
(Contract NAS7-918)
(NASA-Case-NPO-16888-1-CU; NAS 1.71:NPO-16888-1-CU; US-Patent-Appl-SN-133412) Avail: NTIS HC A03/MF A01 CSCL 09A

A low power consumption current transducer utilizes a saturable core reactor which includes a pair of opposed gate windings and a control winding. The control winding of the saturable reactor is arranged to receive the current to be measured. A square wave generator is connected to the gate winding of the transformer connected across the square wave generator and the secondary connected in series with the gate windings of the reactor. A full wave rectifier is connected to the gate windings and a resistor is connected across the rectifier to provide a DC voltage to cross it representative of the current flow through the control winding. A DC power supply is provided to supply power to the square wave voltage source. A diode is connected between each end of the primary winding of the transformer and one polarity of the DC power supply to commutate the reactive current resulting from the counter emf generated in the reactor back to the DC supply to eliminate potentially damaging reactive voltage spikes which would otherwise appear at the output of the square wave generator and conserve energy. NASA

N88-23938# Royal Signals and Radar Establishment, Malvern (England).
MONTE CARLO ANALYSIS OF LATERAL COLLECTION DIODE ARRAYS
A. P. Davis and A. M. White Oct. 1987 17 p
(RSRE-Memo-4080; BR104811; ETN-88-92515) Copyright Avail: NTIS HC A03/MF A01

The determination of the thermally generated, diffusion limited leakage current density of lateral collection diode arrays is considered. It is shown how the simulation of a spot-scan experiment, using a Monte Carlo analysis, can be used to determine the leakage current density of an array of any geometry. It is used to analyze a diode array of hexagonal symmetry as a function of array geometry and bulk diffusion length. The analysis shows that the leakage current of a diode may be substantially reduced by the presence of nearby reverse-biased diodes. ESA

N88-23939*# Induction General, Inc., Pittsburgh, Pa.
HIGH FREQUENCY POWER DISTRIBUTION SYSTEM Final Report
Mikund R. Patel Apr. 1986 159 p
(Contract NAS3-23894)
(NASA-CR-175071; NAS 1.26:175071) Avail: NTIS HC A08/MF A01 CSCL 09C

The objective of this project was to provide the technology of high frequency, high power transmission lines to the 100 kW power range at 20 kHz frequency. In addition to the necessary design studies, a 150 m long, 600 V, 60 A transmission line was built, tested and delivered for full vacuum tests. The configuration analysis on five alternative configurations resulted in the final selection of the three parallel Litz straps configuration, which gave a virtually concentric design in the electromagnetic sense. Low inductance, low EMI and flexibility in handling are the key features of this configuration. The final design was made after a parametric study to minimize the losses, weight and inductance. The construction of the cable was completed with no major difficulties. The R,L,C parameters measured on the cable agreed well with the calculated values. The corona tests on insulation samples showed a safety factor of 3. Author

N88-23940*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
THE LDCM ACTUATOR FOR VIBRATION SUPPRESSION
Eric N. Ide and Douglas K. Lindner [1988] 4 p
(Grant NAG1-719)
(NASA-CR-182898; NAS 1.26:182898) Avail: NTIS HC A02/MF A01 CSCL 09C

A linear dc motor (LDCM) has been proposed as an actuator for the COFS I mast and the COFS program ground test Mini-Mast. The basic principles of operation of the LDCM as an actuator for vibration suppression in large flexible structures are reviewed. Because of force and stroke limitations, control loops are required to stabilize the actuator, which results in a non-standard actuator-plant configuration. A simulation model that includes LDCM actuator control loops and a finite element model of the Mast is described, with simulation results showing the excitation capability of the actuator. Author

N88-23941* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
HERMETICALLY SEALABLE PACKAGE FOR HYBRID SOLID-STATE ELECTRONIC DEVICES AND THE LIKE Patent
Wilson N. Miller, inventor (to NASA) (Rockwell International Corp., Anaheim, Calif.) and Ormal E. Gray, inventor (to NASA) 7 Jun. 1988 7 p Filed 25 Jun. 1982 Supersedes N82-28549 (20 - 19, p 2680)
(NASA-Case-MSC-20181-1; US-Patent-4,750,031; US-Patent-Appl-SN-392093; US-Patent-Class-357-81; US-Patent-Class-357-72; US-Patent-Class-357-74; US-Patent-Class-174-52-S; US-Patent-Class-174-52-PE; US-Patent-Class-174-52-R; US-Patent-Class-525-425) Avail: US Patent and Trademark Office CSCL 09A

A light-weight, inexpensively fabricated, hermetically sealable, repairable package for small electronic or electromechanical units, having multiple connections, is described. A molded ring frame of polyamide-imide plastic (Torlon) is attached along one edge to a base plate formed of a highly heat conducting material, such as aluminum or copper. Bores are placed through a base plate within the area of the edge surface of ring frame which result in an attachment of the ring frame to the base plate during molding. Electrical leads are molded into the ring frame. The leads are L-shaped gold-plated copper wires imbedded within widened portions of the side wall of the ring frame. Within the plastic ring frame wall the leads are bent (typically, though not necessarily at 90 deg) so that they project into the interior volume of the ring frame for connection to the solid state devices.
Official Gazette of the U.S. Patent and Trademark Office

N88-23942* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ARC LAMP POWER SUPPLY USING A VOLTAGE MULTIPLIER Patent
Bradley D. Leighty 2 Feb. 1988 6 p Filed 27 Jun. 1986

Supersedes N86-32626 (24 - 24, P 3719)
(NASA-Case-LAR-13202-1; US-Patent-4,723,096;
US-Patent-Appl-SN-879758; US-Patent-Class-315-254;
US-Patent-Class-315-276; US-Patent-Class-315-277;
US-Patent-Class-315-255; US-Patent-Class-315-200-R;
US-Patent-Class-315-227-R; US-Patent-Class-315-241-R) Avail:
US Patent and Trademark Office CSCL 09A

A power supply is provided for an arc discharge lamp which includes a relatively low voltage high current power supply section and a high voltage starter circuit. The low voltage section includes a transformer, rectifier, variable resistor and a bank of capacitors, while the starter circuit comprises several diodes and capacitors connected as a Cockcroft-Walton multiplier. The starting circuit is effectively bypassed when the lamp arc is established and serves to automatically provide a high starting voltage to re-strike the lamp arc if the arc is extinguished by a power interruption.

Official Gazette of the U.S. Patent and Trademark Office

N88-23792# Naval Weapons Center, China Lake, Calif. Microelectronics Branch.
MICROELECTRONICS THE NEXT FIFTEEN YEARS
Dean Wallace *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 5 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

N88-23857# Naval Surface Weapons Center, Silver Spring, Md. Corrosion Technology Group.
THE EFFECT OF TITANIUM REINFORCEMENT ON THE LIFE OF POSITIVE GRIDS IN LEAD-ACID BATTERIES
W. A. Ferrando and K. L. Vasanth *In* AFWAL, Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 May 1987 p 220-234 (For primary document see N88-23847 17-26)
Avail: NTIS HC A20/MF A01 CSCL 10C

N88-24256*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BENEFITS OF 20 kHz PMAD IN A NUCLEAR SPACE STATION
Gale R. Sundberg *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 7-10 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 09C

N88-24260# RCA Astro-Electronics Div., Princeton, N. J.
PARAMETRIC ANALYSIS OF POWER REQUIREMENTS FOR SPACE-BASED RADAR
B. P. Miller, S. W. McCandless, and L. S. Dreifus *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 23-26 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24261*# General Electric Co., Philadelphia, Pa. Spacecraft Operation.
NUCLEAR ELECTRIC POWER FOR MULTIMEGAWATT ORBIT TRANSFER VEHICLES
R. D. Casagrande *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 27-30 Sponsored by NASA, Lewis Research Center, Cleveland, Ohio, AFOSR, Bolling AFB, Washington, D.C. and AFRPL, Edwards AFB, Calif. (For primary document see N88-24254 17-73)
(Contract F29601-86-C-0238)
Avail: NTIS HC A22/MF A01 CSCL 09C

N88-24308# Sandia National Labs., Albuquerque, N. Mex.
THE EFFECT OF ELEVATED TEMPERATURE ON IRRADIATED MOS DEVICES
D. M. Fleetwood and P. V. Dressendorfer *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 233-236 (For primary document see N88-24254 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A22/MF A01

N88-24309# Sandia National Labs., Albuquerque, N. Mex.
THE RESPONSE OF A POWER MOSFET (N-CHANNEL) AND A DIELECTRIC ISOLATED OPERATIONAL AMPLIFIER TO THE COMBINED ENVIRONMENTAL EFFECTS OF HIGH TEMPERATURE AND TOTAL DOSE GAMMA RADIATION
W. T. Wheelis and S. M. Luker *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 237-240 (For primary document see N88-24254 17-73)
(Contract DE-AC04-75DP-00789)
Avail: NTIS HC A22/MF A01

N88-24314# Boeing Aerospace Co., Seattle, Wash. Electrical Power Systems Technology.
POWER SOURCE SELECTION FOR NEUTRAL PARTICLE BEAM SYSTEMS
Sidney W. Silverman, John W. H. Chi, and Gregory Hill (Westinghouse Electric Corp., Baltimore, Md.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 257-260 (For primary document see N88-24254 17-73)
(Contract DASG60-85-C-0076)
Avail: NTIS HC A22/MF A01

N88-24340# Pacific Northwest Labs., Richland, Wash.
DESIGN OF A SUPERCONDUCTING ALTERNATOR FOR SPACE-BASED POWER GENERATION
Ryan E. Dodge, Jr., Edmund P. Coomes, and James L. Kirtley, Jr. (Massachusetts Inst. of Tech., Cambridge.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 371-376 (For primary document see N88-24254 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A22/MF A01

N88-24391# Argonne National Lab., Ill.
POWER AND ENERGY REQUIREMENTS FOR ELECTROMAGNETIC LAUNCHERS
P. A. Lottes, R. E. Holtz, and K. L. Uherka *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 81-84 (For primary document see N88-24374 17-73)
(Contract W-31-109-eng-38)
Avail: NTIS HC A99/MF A01

N88-24463*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NEUTRON EFFECTS ON THE ELECTRICAL AND SWITCHING CHARACTERISTICS OF NPN BIPOLAR POWER TRANSISTORS
Albert J. Frasca (Wittenberg Univ., Springfield, Ohio.) and Gene E. Schwarze *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 431-435 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 09C

N88-24501*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HIGH POWER DENSITY ELECTRODES FOR AMTEC
C. Perry Bankston, Roger M. Williams, Barbara Jeffries-Nakamura, Mark L. Underwood, and Terry Cole *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 621-623 Sponsored in part by Strategic Defense Initiative Organization, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 09C

N88-24505# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
LIGHTWEIGHT POWER BUS FOR A BASELOAD NUCLEAR REACTOR IN SPACE
Lowell D. Massie, Dennis J. Hoffman, and Charles E. Oberly *In* New Mexico Univ., Transactions of the Fifth Symposium on Space

Nuclear Power Systems 1988 p 643-646 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24506*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE POWER RADIATION COOLED dc TRANSMISSION LINE ANALYSIS
Gene E. Schwarze *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 649-653 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N88-23943*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN EFFICIENT PARALLEL ALGORITHM FOR THE SIMULATION OF THREE-DIMENSIONAL COMPRESSIBLE TRANSITION ON A 20 PROCESSOR FLEX/32 MULTICOMPUTER Final Report
G. Erlebacher, S. H. Bokhari (University of Engineering and Technology, Lahore, Pakistan), and M. Y. Hussaini Jul. 1987 20 p
(Contract NAS1-18107)
(NASA-CR-178340; ICASE-87-41; NAS 1.26:178340) Avail: NTIS HC A03/MF A01 CSCL 20D

The compressible, three-dimensional, time-dependent Navier-Stokes equations are solved on a 20 processor Flex/32 computer. The code is a parallel implementation of an existing code operational on the Cray 2 at NASA Ames which performs direct simulations of the initial stages of the transition process of wall-bounded flow at supersonic Mach numbers. Spectral collocation in all three spatial directions (Fourier along the plate and Chebyshev normal to it) insures high accuracy of the flow variables. By hiding most of the parallelism in low level routines, the casual user is shielded from most of the non-standard coding constructs. Speedups of 13 out of a maximum of 16 are achieved on the largest computational grids. Author

N88-23944# Naval Postgraduate School, Monterey, Calif.
SINGLE PHASE LIQUID IMMERSION COOLING OF DISCRETE HEAT SOURCES IN A VERTICAL CHANNEL M.S. Thesis
Sherrill J. Hazard, III Dec. 1987 160 p
(AD-A191224; AD-E801612) Avail: NTIS HC A08/MF A01 CSCL 09A

Natural convection liquid cooling of simulated electronic components was investigated. A single column of eight protruding components was constructed using foil heaters mounted on the back of stainless steel rectangular blocks. These components were attached to a vertical plexiglass wall to simulate a column of 20 pin DIP's. A channel was formed by placing a smooth movable shrouding wall parallel to the test surface. The test surface and the shrouding wall were placed in a water immersion bath. Flow visualization was accomplished using a laser generated plane of light to illuminate suspended particles. Photographs were taken of the flow at the test surface mid-plane for four different power settings at each of three different channel widths. A nondimensional temperature and a modified Grashof number for each heated protrusion at each input power setting and channel width were determined. GRA

N88-23945# Naval Postgraduate School, Monterey, Calif.
UNSTEADY FLOW ABOUT CAMBERED PLATES Final Report, Oct. 1986 - Oct. 1987
T. Sarpkaya, S. I. Mostafa, and P. D. Munz 1 Oct. 1987 177 p
(AD-A191226; AD-E801612; NPS69-87-012) Avail: NTIS HC A09/MF A01 CSCL 20D

Impulsively-started uniform flow, decelerating at specified rates, about two-dimensional cambered plates with included angles of 120, 180, and 240 degrees has been investigated both theoretically and experimentally. The experiments were conducted in a vertical water tunnel. The forces acting on the cambered plates have determined as a function of the relative displacement of the fluid. The evolution of the vortices was visualized by means of various dyes and polystyrene beads. A numerical analysis was carried out through the use of the discrete vortex model. Vorticity is represented by a distribution of discrete line vortices. Each vortex is convected in the velocity field according to the Biot Savart law. The rollup of the vortex sheets, the distribution of velocity and pressure on the chambers, and the drag and lift forces are calculated at suitable time intervals for a prescribed time-dependent flow. The results are compared with those obtained experimentally. GRA

N88-23946*# National Aeronautics and Space Administration. Pasadena Office, Calif.
CRYOGENIC REGENERATOR INCLUDING SARAN-CARBON HEAT CONDUCTION MATRIX Patent Application
Jack A. Jones, inventor (to NASA), S. Walter Petrick, inventor (to NASA), and Michael J. Britcliffe, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 27 Aug. 1987 25 p
(Contract NAS7-918)
(NASA-Case-NPO-17291-1-CU; NAS 1.71:NPO-17291-1-CU)
Avail: NTIS HC A03/MF A01 CSCL 20D

A saran carbon matrix is employed to conduct heat through the heat storing volume of a cryogenic regenerator. When helium is absorbed into the saran carbon matrix, the combination exhibits a volumetric specific heat much higher than previously used lead balls. A helium adsorbed saran regenerator should allow much lower refrigerator temperatures than those practically obtainable with lead based regenerators for regenerator type refrigeration systems. NASA

N88-23947# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
TESTS ON OSCILLATING FLOWS IN A PIPE NOZZLE WITH AN ABRUPT DIAMETER VARIATION [EXPERIMENTELLE UNTERSUCHUNGEN SCHWINGENDER STROEMUNGEN IN EINER ROHRDUESE MIT QUERSCHNITTSSPRUNG]
W. C. Selerowicz, A. P. Szumowski, and G. E. A. Meier Feb. 1987 100 p In GERMAN
(MPIS-2/1987; ISSN-0436-1199; ETN-88-91925) Avail: NTIS HC A05/MF A01; Max-Planck-Inst. fuer Stroemungsforschung, Boettinger Strasse 6-8, 3400 Goettingen, Federal Republic of Germany 30 Deutsche marks

Results of tests on self excited oscillations in a duct nozzle with an abrupt diameter expansion are given. The effects of nozzle geometry, variation of inlet-outlet duct length, nozzle diameter conditions, and variations of the outlet form of the nozzle were studied. The free jet was analyzed and the difference between an oscillating jet and a steady jet are explained. Pressure oscillations on the outlet duct wall were measured to establish the reasons of the formation of turbulent flow and to permit damping in the duct nozzle. ESA

N88-23948# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France).
MODELING OF CAVITATION PHENOMENA IN HOMOGENEOUS FLOW IN TRANSITORY REGIMES IN PIPES Ph.D. Thesis [MODELISATION, EN ECOULEMENT HOMOGENE, DES PHENOMENES DE CAVITATION LORS DES REGIMES TRANSITOIRES EN CONDUITE]
Mohand Kessal 1987 77 p In FRENCH
(ISAL-IDI1-87-15; ETN-88-92195) Avail: NTIS HC A05/MF A01

Cavitation in transitory regime of a homogeneous gas-liquid mixture in an elastic pipe was studied. For the case where the

two components have the same velocity, it is shown that it is possible to model the flow while conserving the relations and the continuous character of the medium. The flow equations were solved using the standard MacCormack finite difference scheme and the method of characteristics. Measurements confirm model validity. A characteristic formulation for the case where the two components have different velocities was derived. ESA

N88-23949# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.
NUMERICAL METHOD FOR UNSTEADY VISCOUS-INVISCID INTERACTION TO CALCULATE BUFFETING Final Report [METHODE NUMERIQUE D'INTERACTION VISQUEUX-NON VISQUEUX INSTATIONNAIRE POUR LE CALCUL DU BUFFETING]
P. Girodroux-Lavigne and J. C. Leballeur Feb. 1987 39 p In FRENCH
(Contract STPA-88-95-009)
(ONERA-RSF-02/3617-AY-008-A; ETN-88-92294) Avail: NTIS HC A03/MF A01

In order to numerically simulate buffeting, the appearance of unsteady solutions self-induced by transonic separation in the case of a lift surface was analyzed using a viscous-nonviscous, unsteady, two dimensional method, consistent in time with strong coupling. The results show that the method can distinguish between steady and unsteady solutions, depending on the incidence of the profile. Comparisons between calculations and experiments for the RA16SC1 profile are very good for time and frequency distributions of unsteady pressure. The influence of initial conditions and the computational grid are discussed. ESA

N88-23950# Oxford Univ. (England). Dept. of Engineering Science.
NOTE ON THE DOUBLE CRYSTAL METHOD OF MEASURING HEAT TRANSFER COEFFICIENT
P. T. Ireland and T. V. Jones 1987 20 p
(OUEL-1710/87; ETN-88-92531) Avail: NTIS HC A03/MF A01

The sources of error in heat transfer coefficient crystal measurement were analyzed. Test results demonstrated that the cold heat transfer tunnel method (Jones, 1986) could be used successfully in a single crystal mode to measure heat transfer coefficient distribution around a cylinder in a low turbulence, low blockage wind tunnel. However, surprising experimental scatter was encountered when the data from double cyrstal tests were analyzed in the double crystal mode (Jones and Hippensteele, 1987). These earlier measurements within a large duct did not exhibit the same problem. It is shown that care must be exercised in the choice of the starting and liquid crystal color change temperatures to maximize the accuracy of the technique. A method of reducing the sensitivity of the method to time measurement errors is introduced. ESA

N88-23951# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.
DEVELOPMENT AND IMPROVEMENT OF A CODE TO CALCULATE SMALL, THREE DIMENSIONAL, UNSTEADY TRANSONIC PERTURBATIONS Final Report [DEVELOPPEMENT ET AMELIORATION DU CODE DE CALCUL DE PETITES PERTURBATIONS TRANSSONIQUES INSTATIONNAIRES EN TRIDIMENSIONNEL]
P. M. Hutin Nov. 1987 17 p In FRENCH
(Contract STPA-85-95-009)
(ONERA-RTS-31/3064-RY-062-R; ETN-88-92544) Avail: NTIS HC A03/MF A01

A calculation method for transonic, unsteady three dimensional flow was improved to account for finer grid resolution and utilization on a Cray-XMP computer. Comparison of calculation and wind tunnel results shows that it is still not possible to exactly characterize shocks on airfoil surfaces. ESA

N88-23952# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.
ACCOUNTING FOR THE EFFECTS OF UNSTEADY, SEPARATED BOUNDARY LAYERS IN TRANSONIC TWO DIMENSIONAL CALCULATIONS Final Report [PRISE EN COMPTE DES EFFETS DE COUCHE LIMITE INSTATIONNAIRE DECOLLEE DANS LES CALCULS TRANSSONIQUES BIDIMENSIONNELS]
J. P. Grisval Oct. 1987 49 p In FRENCH
(Contract STPA-85-95-004)
(ONERA-RT-30/3064-RY-063-R; ETN-88-92545) Avail: NTIS HC A03/MF A01

An unsteady, implicit calculation method for transonic, viscous, separated, two dimensional flow is presented. The perfect fluid is calculated by a method of small transonic perturbations. Boundary layers and wakes are calculated by an unsteady integral method from upstream to downstream, solved as a direct or inverse problem depending on whether the flow is attached or separated. Coupling is strong and is realized at each time step by a semi-implicit relaxation. The influence on pressure distributions of taking viscous effect into account is shown. It is shown that viscosity effects must be taken into account in three dimensional, transonic calculations. ESA

N88-23953 California Univ., Berkeley.
STUDIES OF HEAT AND MASS TRANSFER DURING CHEMICAL VAPOR DEPOSITION Ph.D. Thesis
Mansoo Choi 1987 176 p
Avail: Univ. Microfilms Order No. DA8726171

A study was made of quasi-steady heat transfer for variable property flow in a rotating tube for a fast-moving torch. The effects of the rotation of the tube and variation of the properties are shown to be important. A second study was made of unsteady heat transfer and particle motion in a rotating tube for a fast moving torch. Particle trajectories and the locations of deposition are shown to depend strongly on the rotation parameter gamma = omega sub alpha/U sub 0. For general torch speeds, a quasi-steady analysis of the heat transfer, particle motion and deposition was carried out for constant properties. The particles exhibited a spiraling motion which covered the entire tube. The results were significantly affected by tube rotation. For all three studies, analytical results for the three-dimensional temperature field were obtained. The findings indicate that tube rotation and variable properties are important in the analysis of heat and mass transfer during modified chemical vapor deposition.
Dissert. Abstr.

N88-23954 Iowa Univ., Iowa City.
SURFACE CURVATURE AND PRESSURE GRADIENT EFFECTS ON TURBULENT FLOW: AN ASSESSMENT BASED ON NUMERICAL SOLUTION OF THE REYNOLDS EQUATIONS Ph.D. Thesis
Marshall Charles Richmond [1987] 265 p
Avail: Univ. Microfilms Order No. DA8729506

A fully elliptic numerical method was developed to solve the Reynolds-averaged Navier-Stokes equations for two-dimensional flows in arbitrary geometries in order to study the joint influence of pressure gradients and surface curvature on turbulent flows. The physical geometry is described using a numerically generated body-fitted coordinate system. The conservation equations of fluid motion in the computational coordinates are obtained by transforming the independent variables, namely the coordinates, as well as the dependent variables, the velocity components. The governing equations are discretized using the finite-analytic method and then solved using a modified version of the SIMPLER algorithm. For turbulent flow, the k-epsilon turbulence model and its variant, proposed to improve the prediction of flows with streamline curvature, are used in conjunction with a one-equation near-wall model. The numerical method is employed in a computational study of several flows involving pressure gradients and surface curvature. The performance of the method and models is examined through two-dimensional computations of flat surface boundary

layers in adverse and favorable pressure gradients, fully developed curved duct flow, and boundary layers on curved surfaces.
Dissert. Abstr.

N88-23955 New South Wales Univ., Kensington (Australia). School of Mechanical Engineering.
NUMERICAL MODELLING OF FLOWS USING PHOENICS M.S. Thesis Abstract Only
Florencio O. Gaa Mar. 1987 240 p
Avail: Issuing Activity

The generalized, all-purpose code PHOENICS for the modelling of heat, mass, and momentum transfer in fluids is evaluated. The concept behind PHOENICS as a program for numerically simulating all sorts of flow is explained. The various models it uses for different purposes are briefly described as well as how these fit into the large framework that makes the program easily adaptable. Also covered are the many methods PHOENICS uses for the solution of the differential equations involved in problems of fluid flow, in other words, its mathematical basis. Several examples of PHOENICS in action are included. The program is used to solve the well known problem of natural convection inside an enclosed cavity with different wall temperatures. The second problem is that of forced convection inside a cavity with a moving lid, whose solution is, like the first, quite well established. The third problem involves two-phase flow, that of boiling inside a vertical pipe heated from the sides. Comparisons are made with known correct solutions, in particular, the Benchmark solution for natural convection and CAV2CON. For the multi-phase problem, a comparison is made with an empirical solution. The results of PHOENICS generally did not tally very well with the other solutions. The main defect was one of accuracy although other minor deficiencies were also revealed. Author

N88-23956*# United Technologies Research Center, East Hartford, Conn.
THE EFFECTS OF INLET TURBULENCE AND ROTOR/STATOR INTERACTIONS ON THE AERODYNAMICS AND HEAT TRANSFER OF A LARGE-SCALE ROTATING TURBINE MODEL. PART 4: AERODYNAMIC DATA TABULATION
R. P. Dring, H. D. Joslyn, and M. F. Blair Nov. 1987 135 p
(Contract NAS3-23717)
(NASA-CR-179469; NAS 1.26:179469; UTRC-R86-956480-4)
Avail: NTIS HC A07/MF A01 CSCL 20D

A combined experimental and analytical program was conducted to examine the effects of inlet turbulence and airfoil heat transfer. The experimental portion of the study was conducted in a large-scale (approx. 5X engine), ambient temperature, rotating turbine model configured in both single-stage and stage-and-a-half arrangements. Heat transfer measurements were obtained using low-conductivity air foils with miniature thermocouples welded to a thin, electrically heated surface skin. Heat transfer data were acquired for various combinations of low or high inlet turbulence intensity, flow coefficient, first stator-rotor axial spacing, Reynolds number and relative circumferential position of the first and second stators. Aerodynamic measurements obtained include distributions of the mean and fluctuating velocities at the turbine inlet and, for each airfoil row, midspan airfoil surface pressures and circumferential distributions of the downstream steady state pressures and fluctuating velocities. Results include airfoil heat transfer predictions produced using existing 2-D boundary layer computation schemes and an examination of solutions of the unsteady boundary layer equations. Author

N88-23957*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HEAT TRANSFER IN AEROSPACE PROPULSION
Robert J. Simoneau, Robert C. Hendricks, and Herbert J. Gladden 1988 48 p Presented at the National Heat Transfer Conference, Houston, Tex., 24-27 Jul 1988; sponsored by ASME, AICE and ANS
(NASA-TM-100874; E-4105; NAS 1.15:100874) Avail: NTIS HC A03/MF A01 CSCL 20D

Presented is an overview of heat transfer related research in support of aerospace propulsion, particularly as seen from the perspective of the NASA Lewis Research Center. Aerospace propulsion is defined to cover the full spectrum from conventional aircraft power plants through the Aerospace Plane to space propulsion. The conventional subsonic/supersonic aircraft arena, whether commercial or military, relies on the turbine engine. A key characteristic of turbine engines is that they involve fundamentally unsteady flows which must be properly treated. Space propulsion is characterized by very demanding performance requirements which frequently push systems to their limits and demand tailored designs. The hypersonic flight propulsion systems are subject to severe heat loads and the engine and airframe are truly one entity. The impact of the special demands of each of these aerospace propulsion systems on heat transfer is explored.
Author

N88-23958* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PUMPED TWO-PHASE HEAT TRANSFER LOOP Patent
Fred Edelstein 14 Jun. 1988 7 p Filed 1 Apr. 1987 Division of US-Patent-4,664,177, US-Patent Appl-SN-755288, dated 15 Jul. 1985
(NASA-Case-MSC-20841-2; US-Patent-4,750,543; US-Patent-Appl-SN-032679; US-Patent-Class-165-1; US-Patent-Class-165-13; US-Patent-Class-165-41; US-Patent-Class-165-104.14; US-Patent-Class-126-423; US-Patent-4,664,177; US-Patent-Appl-SN-755288) Avail: US Patent and Trademark Office CSCL 20D

A pumped loop two-phase heat transfer system, operating at a nearly constant temperature throughout, includes several independently operating grooved capillary heat exchanger plates supplied with working fluid through independent flow modulation valves connected to a liquid supply line, a vapor line for collecting vapor from the heat exchangers, a condenser between the vapor and the liquid lines, and a fluid circulating pump between the condenser and the heat exchangers.
Official Gazette of the U.S. Patent and Trademark Office

N88-23718*# Massachusetts Inst. of Tech., Cambridge.
EXPERIMENTAL MEASUREMENTS OF HEAT TRANSFER FROM AN ICED SURFACE DURING ARTIFICIAL AND NATURAL CLOUD ICING CONDITIONS
Mark S. Kirby and R. John Hansman, Jr. *In* NASA, Langley Research Center, Joint University Program for Air Transportation Research, 1986 Apr. 1988 p 17-26 Previously announced in IAA as A86-39948 Sponsored in cooperation with FAA (For primary document see N88-23715 17-01)
(Grants NGL-22-009-640; NAG3-666)
(AIAA-Paper-86-1352) Avail: NTIS HC A06/MF A01 CSCL 20D

N88-23742*# PRC Kentron, Inc., Hampton, Va. Aerospace Technologies Div.
BOUNDARY LAYER FLOW VISUALIZATION FOR FLIGHT TESTING
Clifford J. Obara *In* NASA, Langley Research Center, Laminar Flow Aircraft Certification May 1986 p 129-140 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 20D

N88-23743*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BOUNDARY LAYER MEASUREMENTS USING HOT-FILM SENSORS
Harlan K. Holmes and Debra L. Carraway (Old Dominion Univ., Norfolk, Va.) *In its* Laminar Flow Aircraft Certification May 1986 p 141-153 (For primary document see N88-23737 17-02)
Avail: NTIS HC A14/MF A01 CSCL 20D

N88-24303# Sundstrand Corp., Rockford, Ill.
TWO-PHASE FLUID MANAGEMENT FOR A RANKINE CYCLE ISOTOPE POWER SYSTEM
Timothy Bland, George Sorensen, and Kenneth Clodfelter *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 209-214 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24341# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
TRANSIENT ANALYSIS OF HEAT PIPE VAPOR DYNAMICS
Daniel B. Klein and Ivan Catton *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 377-380 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24342# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
PROGRESS IN THE COMPUTER MODELING OF THE LIQUID PHASE BEHAVIOR OF A LIQUID METAL HEAT PIPE
Gregory L. Roche and Ivan Catton *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 381-384 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24343# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A COMPRESSIBLE VAPOR FLUX MODEL FOR TRANSIENT HEAT PIPE ANALYSIS
W. Jerry Bowman and James Hitchcock *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 385-388 Sponsored by AFWAL, Wright-Patterson AFB, Ohio (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24344# Idaho National Engineering Lab., Idaho Falls.
ATHENA HEAT PIPE TRANSIENT MODEL
Victor H. Ransom and Hueiming Chow (Exxon Nuclear Co., Inc., Richland, Wash.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 389-392 (For primary document see N88-24254 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A22/MF A01

N88-24345# Costello (Frederick A.), Inc., Herndon, Va.
DETAILED TRANSIENT MODEL OF A LIQUID-METAL HEAT PIPE
Frederick A. Costello, Allen F. Montague, Michael A. Merrigan, and Robert Reid (Los Alamos National Lab., N. Mex.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 393-402 Previously announced as N87-10257 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24346# Los Alamos National Lab., N. Mex.
THERMOCHEMICAL ANALYSIS OF MASS TRANSFER IN A NB-1ZR-POTASSIUM HEAT PIPE
Roy C. Feber and Michael A. Merrigan *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 403-406 (For primary document see N88-24254 17-73)
(Contract W-7405-eng-36)
Avail: NTIS HC A22/MF A01

N88-24347# North Carolina State Univ., Raleigh. Dept. of Nuclear Engineering.
TRANSIENT THERMOHYDRAULIC HEAT PIPE MODELING
Michael L. Hall and Joseph M. Doster *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 407-410 Sponsored by DOE, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24386# Brookhaven National Lab., Upton, N. Y.
THEORETICAL PREDICTION OF SINGLE PHASE TURBULENT FLOW DISTRIBUTION IN PARTICULATE BED REACTORS
Robert F. Benenati and Fredrick L. Horn *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 51-54 (For primary document see N88-24374 17-73)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC A99/MF A01

N88-24394# Pacific Northwest Labs., Richland, Wash.
A REFLUX TUBE FABRIC RADIATOR
Edmund P. Coomes and Joseph M. Kelly *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 93-97 (For primary document see N88-24374 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A99/MF A01

N88-24395*# Sverdrup Technology, Inc., Cleveland, Ohio.
THE LEWIS HEAT PIPE CODE WITH APPLICATION TO SP-100 GES HEAT PIPES
Karl W. Baker and Leonard K. Tower *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 99-103 Sponsored by NASA, Lewis Research Center, Cleveland, Ohio (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 20D

N88-24396# Los Alamos National Lab., N. Mex.
HTPIPE: A STEADY STATE HEAT PIPE ANALYSIS PROGRAM
Keith A. Woloshun and Michael A. Merrigan *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 105-108 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24397# Pacific Northwest Labs., Richland, Wash.
HEAT PIPE TRANSIENT ANALYSIS: VAPOR DYNAMICS
Joseph M. Kelly *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 109-113 Previously announced as N88-20568 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24398# New Mexico Univ., Albuquerque. Inst. for Space Nuclear Power Studies.
A TRANSIENT MODEL FOR LIQUID METAL HEAT PIPES
Jong T. Seo and Mohamed S. El-Genk *In its* Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 114-119 (For primary document see N88-24374 17-73)
(Contract F29601-84-C-0080)
Avail: NTIS HC A99/MF A01

N88-24399# Los Alamos National Lab., N. Mex.
THE THROHPUT CODE: THERMOHYDRAULIC HEAT PIPE MODELING
Michael L. Hall and Joseph M. Doster (North Carolina State Univ., Raleigh.) *In its* Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 121-126 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24415# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
LIQUID DROPLET RADIATOR DEVELOPMENT
J. B. Blackmon, D. G. Brown, R. E. Drubka, R. A. Gerrick, J. L. McNichols, and D. K. Edwards (California Univ., Irvine.) *In* New

Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 199-204 (For primary document see N88-24374 17-73)
(Contract F04611-86-C-0111)
Avail: NTIS HC A99/MF A01

N88-24418# Sandia National Labs., Albuquerque, N. Mex.
MACRAD: A MASS ANALYSIS CODE FOR RADIATORS
Donald R. Gallup *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 217-220 (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01

N88-24419# Los Alamos National Lab., N. Mex. Advanced Engineering Technology.
HEAT PUMP-AUGMENTED SYSTEMS FOR SPACECRAFT THERMAL MANAGEMENT
Michael A. Merrigan and Robert S. Reid *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 221-226 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24420# Westinghouse Electric Corp., Madison, Pa. Advanced Energy Systems Div.
THE CURIE POINT RADIATOR
Mario D. Carelli, Robert A. Markley, Bill L. Pierce, and J. Ed Schmidt *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 227-230 (For primary document see N88-24374 17-73)
(Contract DE-AC03-85SF-15936)
Avail: NTIS HC A99/MF A01

N88-24435# Pacific Northwest Labs., Richland, Wash.
FABRIC RADIATORS
Zenen I. Antoniak and Michael G. Jacox (Air Force Weapons Lab., Kirtland AFB, N. Mex.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 303-306 Sponsored by AFWL, Kirtland AFB, N. Mex. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24436# Ebasco Services, Inc., New York.
A MULTIMEGAWATT SPACE POWER SOURCE RADIATOR DESIGN
Jacek Jedruch *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 307-311 (For primary document see N88-24374 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A99/MF A01

N88-24437# Air Force Inspection and Safety Center, Kirtland AFB, N. Mex. Weapons and Special Projects Branch.
THE LIQUID DROPLET RADIATOR IN SPACE: A PARAMETRIC APPROACH
Gerald L. Buckner and Ronald F. Tuttle (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 313-316 Sponsored by the Department of the Air Force, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24448# Pacific Northwest Labs., Richland, Wash.
DEVELOPMENT OF MATERIALS FOR FABRIC RADIATORS
John T. Prater and James M. Bates *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 361-364 Sponsored in part by AFWL, Kirtland AFB, N. Mex. (For primary document see N88-24374 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A99/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N88-23959*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CYLINDRICAL SURFACE PROFILE AND DIAMETER MEASURING TOOL AND METHOD Patent Application
James R. Currie, inventor (to NASA), Ralph R. Kissel, inventor (to NASA), Earnest C. Smith, inventor (to NASA), Charles E. Oliver, inventor (to NASA), John W. Redmon, Sr., inventor (to NASA), Charles C. Wallace, inventor (to NASA), and Charles P. Swanson, inventor (to NASA) (Teledyne Brown Engineering, Huntsville, Ala.) 18 Nov. 1987 17 p
(NASA-Case-MFS-28287-1; NAS 1.71:MFS-28287-1; US-Patent-Appl-SN-122740) Avail: NTIS HC A03/MF A01 CSCL 14B

A tool is shown having a cross beam assembly made of beams joined by a center box structure. The assembly is adapted to be mounted by brackets to the outer end of a cylindrical case. The center box structure has a vertical shaft rotatably mounted therein and extending beneath the assembly. Secured to the vertical shaft is a radius arm which is adapted to rotate with the shaft. On the longer end of the radius arm is a measuring tip which contacts the cylindrical surface to be measured and which provides an electric signal representing the radius of the cylindrical surface from the center of rotation of the radius arm. An electric servomotor rotates the vertical shaft and an electronic resolver provides an electric signal representing the angle of rotation of the shaft. The electric signals are provided to a computer station which has software for its computer to calculate and print out the continuous circumference profile of the cylindrical surface, and give its true diameter and the deviations from the ideal circle. NASA

N88-23960*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DUAL WAVELENGTH HOLOGRAPHIC INTERFEROMETRY SYSTEM Patent Application
William K. Witherow, inventor (to NASA) and Andreas Ecker, inventor (to NASA) (European Space Agency, Paris, France) 29 Jan. 1988 10 p
(NASA-Case-MFS-28242-1; NAS 1.71:MFS-28242-1; US-Patent-Appl-SN-149822) Avail: NTIS HC A02/MF A01 CSCL 14B

A two-wave holographic interferometry system and method is described. In such systems, a reference beam holographic is superimposed on an object beam, the object beam being an image obtained by passing a beam through an object regarding which some parameter (e.g., temperature gradient) is to be measured. A photograph of the superimposed beams is taken. This invention employs two object and two reference beams and the invention is particularly concerned with the use of a prism assembly which causes the two different wavelengths of the object beams to emerge from the prism at slightly different angles, thereby providing two holographic images which are slightly displaced from each other. NASA

N88-23961*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRESSURE MEASURING PROBE Patent Application
George C. Ashby, Jr. 13 Jan. 1988 10 p
(NASA-Case-LAR-13853-1; NAS 1.71:LAR-13853-1; US-Patent-Appl-SN-143436) Avail: NTIS HC A02/MF A01 CSCL 14B

The invention is a probe for measuring changes in pressure in a high velocity fluid stream over and adjacent to the surface of an object. The probe is formed of an exterior housing having a

closed pressure chamber in which a piezoelectric pressure transducer is mounted. An open connector tube having a probe tip passes a portion of the fluid stream into the closed pressure chamber; any change of pressure within which requires a settling-time to appear in the closed pressure chamber that is inversely proportional to the cross-sectional area of the connector tube. A cooling chamber formed around the pressure chamber is connected to a source of cooling fluid by means of inlet and outlet tubes. NASA

N88-23962*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THERMAL REMOTE ANEMOMETER SYSTEM Patent Application
Joseph S. Heyman, inventor (to NASA), Christopher Welch, inventor (to NASA) (College of William and Mary, Williamsburg, Va.), William E. Miller, inventor (to NASA), D. Michele Heath, inventor (to NASA), and William P. Winfree, inventor (to NASA) 22 Jan. 1988 13 p
(NASA-Case-LAR-13508-1; NAS 1.71:LAR-13508-1; US-Patent-Appl-SN-146939) Avail: NTIS HC A03/MF A01 CSCL 14B

A sample in a wind tunnel is radiated from a thermal energy source located outside the wind tunnel. A thermal imager system, also located outside the wind tunnel, reads surface radiations from the sample as a function of time. The thermal images produced are characteristic of the heat transferred from the sample to the flow across the sample. In turn, the measured rates of heat loss of the sample are characteristic of the flow and the sample. NASA

N88-23963*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MINING VOLUME MEASUREMENT SYSTEM Patent Application
Joseph Saul Heyman, inventor (to NASA) 22 Jan. 1988 11 p
(NASA-Case-LAR-13519-1; NAS 1.71:LAR-13519-1; US-Patent-Appl-SN-146938) Avail: NTIS HC A03/MF A01 CSCL 14B

In a shaft with a curved or straight primary segment and smaller off-shooting segments, at least one standing wave is generated in the primary segment. The shaft has either an open end or a closed end and approximates a cylindrical waveguide. A frequency of a standing wave that represents the fundamental mode characteristic of the primary segment can be measured. Alternatively, a frequency differential between two successive harmonic modes that are characteristic of the primary segment can be measured. In either event, the measured frequency or frequency differential is characteristic of the length and thus the volume of the shaft based on length times the bore area. NASA

N88-23964# Grenoble-1 Univ., Saint Martin d'Heres (France). Lab. d'Informatique Fondamentale et d'Intelligence Artificielle.
CONVERSATIONAL ANALYSIS OF COLOR IMAGES (CAICOU): AN INTERACTIVE DEVELOPMENT SYSTEM FOR THE ANALYSIS OF COLOR IMAGES [CAICOU: UN SYSTEME DE DEVELOPPEMENT INTERACTIF POUR L'ANALYSE D'IMAGES EN COULEUR]
Jose Luis Gordillo Mar. 1987 29 p In FRENCH; ENGLISH summary Revised
(RR-641-I-IMAG-39-LIFIA; ETN-88-92276) Avail: NTIS HC A03/MF A01

The CAICOU (Conversational Analysis of Color Images) system is an interactive environment that simplifies the use and the implementation of algorithms for the analysis of color images is described. Processing is performed in two simultaneous steps: the extraction of contrast features to build closed regions, and the analysis of these regions to detect homogeneous features. The logical parallelism is implemented by incremental algorithms for optimal control. Color information is important for both steps: providing the best color component to the operator of contrast extraction, and characterizing region homogeneities by their color features. The CAICOU was successfully applied for the identification of electrical wires in stereo color images, and supports the system development for the synthesis of vision programs from assembling description. ESA

N88-23965 New South Wales Univ., Sydney (Australia).
THEORY OF NEUTRON MOISTURE PROBES AND INTERPRETATION OF MEASUREMENTS IN COMPLEX SOIL AND WATER SYSTEMS Ph.D. Thesis Abstract Only
David J. Wilson 1986 190 p
Avail: Issuing Activity

Multigroup diffusion theory is used to calculate the effects of soil moisture density, dry soil density, neutron absorption, and scattering cross sections on the thermal flux resulting from a fast neutron source in the soil. Empirical formulae are fitted to the results of these calculations resulting in a mathematical representation of the soil characteristics. These formulae and their derivations are incorporated into a computer code AVON which may be used to calculate a neutron probe calibration curve for a soil of known parameters or used on-line to calculate moisture densities from a series of sets of soil parameters and count rates. The derivatives are used to calculate the errors in the moisture density arising from limitations in the accuracy of the soil parameters. Further calculations were applied to models representing borehole liners, the presence of water density gradients and duplex soils and some experimental comparisons are made. All of these perturbations can introduce large errors in the estimate of water density. However, it is demonstrated that it is possible to describe and correct these effects using simple empirical polynomials incorporated into the program AVON. An account is given of the use of the AVON program to determine the water density down a 20 m deep borehole through a mine overburden heap. Using the technique it is now possible to extend the use of neutron moisture probes into heterogeneous or perturbed systems with some degree of confidence, or to compare water measurements in different systems. Author

N88-23966* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ACOUSTIC EMISSION FREQUENCY DISCRIMINATION Patent
Frank E. Sugg, inventor (to NASA) and Lloyd J. Graham, inventor (to NASA) (Rockwell International Science Center, Thousand Oaks, Calif.) 19 Apr. 1988 8 p Filed 12 Jun. 1986 Supersedes N87-14676 (25 - 06, p 776)
(NASA-Case-MSC-20467-1; US-Patent-4,738,137; US-Patent-Appl-SN-874319; US-Patent-Class-73-587; US-Patent-Class-73-801) Avail: US Patent and Trademark Office CSCL 14B

In acoustic emission nondestructive testing, broadband frequency noise is distinguished from narrow banded acoustic emission signals, since the latter are valid events indicative of structural flaws in the material being examined. This is accomplished by separating out those signals which contain frequency components both within and beyond (either above or below) the range of valid acoustic emission events. Application to acoustic emission monitoring during nondestructive bond verification and proof loading of undensified tiles on the Space Shuttle Orbiter is considered.
Official Gazette of the U.S. Patent and Trademark Office

N88-23967* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BEARING-BYPASS MATERIAL SYSTEM TEST Patent
John H. Crew, Jr., inventor (to NASA) 12 Jan. 1988 4 p Filed 12 Feb. 1987 Supersedes N87-25556 (25 - 19, p 2611)
(NASA-Case-LAR-13458-1; US-Patent-4,718,281; US-Patent-Appl-SN-013802; US-Patent-Class-73-794; US-Patent-Class-73-810) Avail: U.S. Patent and Trademark Office CSCL 14B

A material specimen containing a central hole is bolted between two bearing guide plates. An applied load control exerts an applied load, either tension or compression, to one end of the specimen and a bypass load control applies a bypass load to the other end of the specimen. Both load controls have their control inputs supplied by a single input signal generator. The difference between

the applied load and the bypass load is transmitted through the bolt and plate to the bearing load cells.
Official Gazette of the U.S. Patent and Trademark Office

N88-23968*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
FIBER WAVEGUIDE SENSORS FOR INTELLIGENT MATERIALS Final Report
A. R. Flax and R. O. Claus Jun. 1988 306 p
(Grant NAG1-780)
(NASA-CR-183028; NAS 1.26:183028) Avail: NTIS HC A14/MF A01 CSCL 14B
This report, an addendum to the six month report submitted to NASA Langley Research Center in December 1987, covers research performed by the Fiber and Electro-Optics Research Center (FEORC) at Virginia Tech for the NASA Langley Research Center, Grant NAG1-780, for the period from December 1987 to June 1988. This final report discusses the research performed in the following four areas as described in the proposal: Fabrication of Sensor Fibers Optimized for Embedding in Advanced Composites; Fabrication of Sensor Fiber with In-Line Splices and Evaluation via OTR methods; Modal Domain Optical Fiber Sensor Analysis; and Acoustic Fiber Waveguide Implementation. Author

N88-23896*# Wisconsin Univ., Madison. Instrumentation Systems Center.
RADIATION THERMOMETRY: THE MEASUREMENT PROBLEM
G. D. Nutter *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 3-63 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 14B

N88-23897*# National Bureau of Standards, Washington, D.C. Center for Radiance Research.
THE NBS SCALE OF RADIANCE TEMPERATURE Abstract Only
William R. Waters, James H. Walker, and Albert T. Hattenburg *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 64 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 14B

N88-24087# Universidade Federal de Parana, Curitiba (Brazil).
THE 35 mm VERTICAL AERIAL PHOTOGRAPHS FOR MAPPING STANDS OF BRACATINGA IN DIFFERENT AGE CLASSES [FOTOGRAFIAS AERAS VERTICAIS 35 MM PARA MAPEAR POVOAMENTOS DE BRACATINGA EM DIFERENTES IDADES]
Attilio Antonio Disperati, Nelson Carlos Rosot, and Joao RobertodosSantos *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 716-723 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24091# Universidade Federal de Parana, Curitiba (Brazil). Departamento de Silvicultura e Manejo.
STEREOSCOPIC PHOTOGRAPHS, GROUND AND AERIAL, OF TREES USED IN THE ARBORIZATION OF CURITIBA (PR) [FOTOGRAFIAS ESTEROSCOPICAS, TERRESTRES E AEREAS, DE ARVORES UTILIZADAD NA ARBORIZACAO DE CURITIBI - PR]
Attilio Antonio Disperati and Carlos Vellozo Roderjan *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 757-763 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24135# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
BOTANY FACILITY. THERMAL CONTROL (TC) SUBSYSTEM TEST REPORT ON EXPERIMENT CONTAINER OF LABORATORY MODEL AND BREADBOARD CENTRIFUGE
W. Fischer *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 36 p (For primary document see N88-24130 17-51)
(BF-TN-ER-061/86) Copyright Avail: NTIS HC A17/MF A01

N88-24136# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
BOTANY FACILITY: TEST REPORT ON BREADBOARD TESTS FOR THE DETERMINATION OF THE HEAT TRANSFER AT THE GLASS DISK AND OF THE TEMPERATURE DISTRIBUTION IN THE FLUORESCENT TUBE [BOTANY FACILITY: TESTBERICHT DER BREADBOARD-TESTS ZUR ERMITTLUNG DES WAERMEUBERGANGES AN DER GLASSCHEIBE UND DER TEMPERATURVERTEILUNG AN DER LEUCHTSTOFFROEHRE]
W. Fischer *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 110 p In GERMAN (For primary document see N88-24130 17-51)
(BF-TN-ER-053) Copyright Avail: NTIS HC A17/MF A01

N88-24137# Sira Inst. Ltd., Chislehurst (England). Research and Development Div.
BOTANY FACILITY: BREADBOARDING RESULTS OF THE ILLUMINATION SYSTEM
M. A. Cutter *In* MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 15 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP110/MAC003) Copyright Avail: NTIS HC A17/MF A01

N88-24477# Idaho National Engineering Lab., Idaho Falls.
LOW CROSS-SECTION Mo-Nb THERMOCOUPLES FOR NUCLEAR APPLICATION: THE STATE-OF-THE-ART
S. Curtis Wilkins *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 499-502 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24478# Westinghouse Hanford Co., Richland, Wash.
DEVELOPMENT OF REFRACTORY THERMOCOUPLES FOR SPACE NUCLEAR POWER TESTS
R. Craig Knight and Larry H. Schoenlein (Pacific Northwest Labs., Richland, Wash.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 503-506 (For primary document see N88-24374 17-73)
(Contract DE-AC06-87RL-10930)
Avail: NTIS HC A99/MF A01

N88-24479# Superior Electric Co., Bristol, Conn.
ANGULAR POSITION MEASUREMENTS AT HIGH TEMPERATURES AND HIGH RADIATION ENVIRONMENTS
Robert S. Lundin *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 509-511 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24480# Oak Ridge National Lab., Tenn.
JOHNSON NOISE THERMOMETER FOR HIGH-RADIATION AND HIGH-TEMPERATURE ENVIRONMENTS
Lester C. Oakes and Robert L. Shepard *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 515-519 Previously announced as N88-17911 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N88-23969# Institut National Polytechnique, Grenoble (France).
MONOLITHIC INTEGRATION ON A GaAs SUBSTRATE OF A QUARTER RING LASER AND AN OPTICAL GUIDE COUPLED BY AN EVANESCENT WAVE Ph.D. Thesis [INTEGRATION MONOLITHIQUE SUR SUBSTRAT GAAS D'UN LASER EN QUART DE CERCLE ET D'UN GUIDE OPTIQUE COUPLES PAR ONDE EVANESCENTE]
Herve Ribot 1987 224 p In FRENCH; ENGLISH summary
(ETN-88-92308) Avail: NTIS HC A11/MF A01

Quarter ring buried lasers were fabricated by using metallorganic epitaxy, ion etching, and liquid phase epitaxy. Threshold currents as low as 23 mA are reported. A theoretical study of evanescent coupling in a straight laser cavity reveals that transmission in the guide is sharply dependent on the wave synchronism of the active layer and the guide. The integration of a separate confinement laser is proposed to relax the technological constraint. The coupling is experimentally achieved with a simple cavity. A concept of integration of a quarter ring laser with an optical guide is demonstrated. The threshold current of the component is 50 mA; a 10 mW emission with a spectral line width of 1.7 A is measured from the guide. ESA

N88-23970# Institut de Mecanique des Fluides de Marseille (France).
REALIZATION OF AN XeCl LASER PRODUCING 100W ON AVERAGE Final Report [REALISATION D'UN LASER A XECL DELIVRANT 100 WATTS MOYENS]
Ph. Delaporte, B. Fontaine, B. Forestier, and M. Sentis Nov. 1987 77 p Partly in ENGLISH and FRENCH
(Contract DRET-84-147)
(ETN-88-92541) Avail: NTIS HC A05/MF A01

Phenomena limiting the possibility to produce an XeCl excimer laser with an output greater than 100 W were studied. Laser kinetics were modeled and the aerodynamic waves produced by the excitation of the gas, and the coupling of these waves, were investigated. The study proves the feasibility of X-ray generation by a secondary emission electron gun. The importance of transverse acoustic waves in the laser cavity is shown. A detector to evaluate energy distribution in the laser beam, capable of operating at frequencies of 1000 Hz was built. ESA

N88-23971*# Old Dominion Univ., Norfolk, Va. Dept. of Physics.
THEORETICAL STUDIES OF SOLAR-PUMPED LASERS Progress Report, 16 Jan. - 15 Jun. 1988
Wynford L. Harries Jun. 1988 18 p
(Grant NsG-1568)
(NASA-CR-182929; NAS 1.26:182929; PTR-88-5) Avail: NTIS HC A03/MF A01 CSCL 20E

The investigation of stimulated emission causing transitions from the B(1) pi sub u state of sodium to the overlapping 2(1) sigma(+) sub g electronic state has been continued. A new method of estimating the Franck-Condon factors has been developed which instead of fitting the molecular potential curves with Morse functions, estimates the V(r) dependence by interpolation from given potential curves. The results for the sum of the rates from one vibrational level in the upper state to all the levels in the lower state show good agreement with the previous method, implying that curve crossing by stimulated emission due to photons from the oven is an important mechanism in sodium. Author

N88-23972*# Old Dominion Univ., Norfolk, Va. Dept. of Mathematical Sciences.
THEORETICAL STUDIES OF SOLAR LASERS AND CONVERTERS Progress Report, Jan. - Jul. 1988
John H. Heinbockel Jun. 1988 22 p
(Grant NAG1-757)
(NASA-CR-182927; NAS 1.26:182927) Avail: NTIS HC A03/MF A01 CSCL 20E

The previously constructed one dimensional model for the simulated operation of an iodine laser assumed that the perfluoroalkyl iodide gas n-C3F7I was incompressible. The present study removes this simplifying assumption and considers n-C3F7I as a compressible fluid. Author

N88-24289# Missouri Univ., Columbia. Dept. of Nuclear Engineering.
SPACE BASED NUCLEAR-PUMPED LASER/REACTOR CONCEPTS
Guoxiang Gu, Mark A. Prelas, and Jay F. Kunze *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 143-147 (For primary document see N88-24254 17-73)
(Grant NSF CBT-83-52345)
Avail: NTIS HC A22/MF A01

N88-24405# Missouri Univ., Columbia. Nuclear Engineering Program.
NEUTRONICS CONCEPTUAL DESIGN OF A UF6-FUELED GASESOUS LASER SYSTEM
Guo-Xiang Gu, Jay F. Kunze, Frederick P. Boody, and Mark A. Prelas *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 149-152 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N88-23973*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MAGNETIC DRIVE COUPLING Patent Application
Edward L. Carter, inventor (to NASA) (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.) 18 Dec. 1987 14 p
(NASA-Case-MSC-21171-1; NAS 1.71:MSC-21171-1; US-Patent-Appl-SN-135120) Avail: NTIS HC A03/MF A01 CSCL 13I

The driving and driven members of a magnetic drive are separated by en enlarged gap to provide clearance for a conduit or other member. Flux pins in the gap maintain the torque transmitting capability of the drive. The spacing between two of the flux pins is increased to provide space for the conduit. NASA

N88-23974*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ROTOR SELF-LUBRICATING AXIAL STOP Patent Application
Dale H. Blount 29 Jan. 1988 11 p
(NASA-Case-MFS-28273-1; NAS 1.71:MFS-28273-1; US-Patent-Appl-SN-149830) Avail: NTIS HC A03/MF A01 CSCL 13I

A series of lubricating plugs is located in the stationary backup face adjacent to the axial stop face of a rotating impeller mounted in a turbopump for pumping liquid oxygen or liquid hydrogen. The stop face and the backup face are those surfaces which engage when the axial load on the impeller exceeds the load balancing capability. The plugs have a truncated conical configuration so as to be trapped in the backup face, and are placed at varying radii on the face to provide complete surface lubrication. The plugs may be formed from Teflon, Kel-F or bronze filled Teflon. NASA

N88-23975 Cincinnati Univ., Ohio.
A DESIGN ANALYSIS FOR AN AUTOMATED ROBOTIC WORKPIECE MANIPULATOR Ph.D. Thesis
Hsueh-Chao Huang [1987] 257 p
Avail: Univ. Microfilms Order No. DA8729271

A method is created for the optimal design of robotic manipulators based on predicting static deflections of the end effector through kinematic analysis. The proposed method uses

the Denavit-Hartenberg system of kinematic notation, and application of the homogeneous transformation matrix. The forward kinematic equations are used to calculate the deflections of the end-effector at its work position. These initial deflections are then used as reference data for solving the inverse kinematic equation. The proposed method is first applied to a single link, considering both revolute and prismatic joints under all considerations of loading, and taking into account the concepts of a rigid joint with a resilient body and a rigid body with a resilient joint. The proposed method is then applied to successively more complex combinations of joints and links. Finally, consideration is given to how control system sensors mounted in the joints can be used to control deflection of an operating robot and application of control system. In contrast to the widely used finite-element approach to robot design, the proposed method provides continuing guidance for the decisions which must be made in the process of designing a robotic manipulator. Dissert. Abstr.

N88-23976 California Univ., Los Angeles.
POINT ACCESSIBILITY AND PRIMARY WORKSPACE OF SIMPLE SIX-LINK ROBOTS Ph.D. Thesis
Eugene Yuh-Ji Lin [1987] 149 p
Avail: Univ. Microfilms Order No. DA8728702

An analytical study on the point accessibility and the primary workspace of some simple, six-link robots is presented. The approach is to divide the structure of a six-link robot into two subsystems: the regional structure and the wrist. Taking advantage of the kinematic simplicity of three-link subsystems, at the same time the problem of reassembling the subsystems is solved by using the concept of vector fields at the connection. Two types of wrist, the Euler-Angle and the Roll-Pitch-Yaw, in conjunction with the four basic standard types of regional structures, the PPP cartesian, the RPP cylindrical, the RRP spherical, and the RRR articulated are considered. Criteria for these robots to access points from specific directions are initially developed. Then theorems for accessing points from all directions are derived. Several clean statements on the boundaries of primary workspace are made. The dexterity of robots with joint limitation is also studied. A discussion of the effect of the design of the wrist and the regional structure of a robot on optimal performance in the workspace and the primary workspace is included. Robots with a skew attachment angle between the wrist and regional structure are also discussed. Dissert. Abstr.

N88-23977*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VIBRATION AND CONTROL OF FLEXIBLE ROTOR SUPPORTED BY MAGNETIC BEARINGS
Kenzou Nonami [1988] 23 p Presented at the 1st International Conference on Magnetic Bearings, Zurich, Switzerland, 6-8 Jun. 1988; sponsored in part by the Swiss Federal Inst. of Technology, and the Swiss Society of Microtechnics
(NASA-TM-100888; E-4123; NAS 1.15:100888) Avail: NTIS HC A03/MF A01 CSCL 13E

Active vibration control of flexible rotors supported by magnetic bearings is discussed. Using a finite-element method for a mathematical model of the flexible rotor, the eigenvalue problem is formulated taking into account the interaction between a mechanical system of the flexible rotor and an electrical system of the magnetic bearings and the controller. However, for the sake of simplicity, gyroscopic effects are disregarded. It is possible to adapt this formulation to a general flexible rotor-magnetic bearing system. Controllability with and without collocation sensors and actuators located at the same distance along the rotor axis is discussed for the higher order flexible modes of the test rig. In conclusion, it is proposed that it is necessary to add new active control loops for the higher flexible modes even in the case of collocation. Then it is possible to stabilize for the case of uncollocation by means of this method. Author

N88-23978* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL STRESS MINIMIZED, TWO COMPONENT, TURBINE SHROUD SEAL Patent
Robert F. Handschuh, inventor (to NASA) 1 Mar. 1988 12 p Filed 18 Jun. 1986 Supersedes N86-32740 (24 - 24, P 3735)
(NASA-Case-LEW-14212-1; US-Patent-4,728,257; US-Patent-Appl-SN-875798; US-Patent-Class-415-136; US-Patent-Class-415-170-R) Avail: US Patent and Trademark Office CSCL 13I

In a turbine machine, a two-component shroud seal which maximizes insulation and sealing around the rotating turbine blades, and is made by independently fabricating each of the two components then joining them together, is disclosed. The two components may be joined together at room temperature. The resulting shroud seal provides greater engine efficiency and thrust. Official Gazette of the U.S. Patent and Trademark Office

N88-23979* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BI-STEM GRIPPING APPARATUS Patent
Fred G. Sanders, inventor (to NASA) 9 Feb. 1988 7 p Filed 3 Jun. 1987 Supersedes N87-25586 (25 - 19, p 2616)
(NASA-Case-MFS-28185-1; US-Patent-4,723,800; US-Patent-Appl-SN-056930; US-Patent-Class-294-16; US-Patent-Class-294-106; US-Patent-Class-294-113; US-Patent-Class-294-119.2) Avail: US Patent and Trademark Office CSCL 13I

This invention relates to devices which grip cylindrical structures and more particularly to a device which has three arcuate gripping members having frictional surfaces for gripping and compressing a bi-stem. The bi-stem gripping apparatus is constructed having a pair of side gripping members, and an intermediate gripping member disposed between them. Sheets of a gum stock silicone rubber with frictional gripping surfaces are bonded to the inner region of the gripping members and provide frictional engagement between the bi-stem and the apparatus. A latch secures the gripping apparatus to a bi-stem, and removable handles are attached, allowing an astronaut to pull the bi-stem from its cassette. A tethering ring on the outside of the gripping apparatus provides a convenient point to which a lanyard may be attached.
Official Gazette of the U.S. Patent and Trademark Office

N88-23980* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WELDING TORCH GAS CUP EXTENSION Patent
Stephen S. Gordon, inventor (to NASA) (Rockwell International Corp., Huntsville, Ala.) 7 Jun. 1988 5 p Filed 30 Apr. 1987 Superseded N87-25587 (25 - 19, p 2616)
(NASA-Case-MFS-29252-1; US-Patent-4,749,839; US-Patent-Appl-SN-044181; US-Patent-Class-219-75; US-Patent-Class-219-137.42) Avail: US Patent and Trademark Office CSCL 13I

The invention relates to a gas shielded electric arc welding torch having a detachable gas cup extension which may be of any desired configuration or length. The gas cup extension assembly is mounted on a standard electric welding torch gas cup to enable welding in areas with limited access. The gas cup assembly has an upper tubular insert that fits within the gas cup such that its lower portion protrudes thereform and has a lower tubular extension that is screwed into the lower portion. The extension has a rim to define the outer perimeter of the seat edge about its entrance opening so a gasket may be placed to effect an airtight seal between the gas cup and extension. The tubular extension may be made of metal or cermaic material that can be machined. The novelty lies in the use of an extension assembly for a standard gas cup of an electric arc welding torch which extension assembly is detachable permitting the use of a number of extensions which may be of different configurations and materials and yet fit the standard gas cup.
Official Gazette of the U.S. Patent and Trademark Office

N88-23981* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPOSITE PISTON Patent
Allan H. Taylor, inventor (to NASA) 12 Apr. 1988 10 p Filed 30 Jul. 1986 Supersedes N87-15464 (25 - 07, p 908)
(NASA-Case-LAR-13435-1; US-Patent-4,736,676;
US-Patent-Appl-SN-890683; US-Patent-Class-92-212;
US-Patent-Class-92-176; US-Patent-Class-92-214;
US-Patent-Class-92-222; US-Patent-Class-92-224;
US-Patent-Class-123-193-P) Avail: US Patent and Trademark Office CSCL 13I

A composite piston structure is disclosed which provides a simple and reliable means for joining a carbon-carbon or ceramic piston cap with a metallic piston body. Attachment is achieved by means of a special geometry which compensates for differences in thermal expansion without complicated mechanical fastening devices. The shape employs a flange created by opposed frustoconical shapes with coincident vertices intersecting on the radial centerline of the piston in order to retain the piston cap. The use of carbon-carbon for the piston cap material allows a close fit between the piston and a cylinder wall, eliminating the need for piston rings. The elimination of extra mechanical parts of previous composite pistons provides a lightweight composite piston capable of extended high temperature operation.

Official Gazette of the U.S. Patent and Trademark Office

N88-23982* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
VARIABLE RESPONSE LOAD LIMITING DEVICE Patent
Dwight D. McSmith, inventor (to NASA) 19 Jan. 1988 9 p Filed 6 Oct. 1981 Supersedes N82-20544 (20 - 11, p 1515)
(NASA-Case-LAR-12801-1; US-Patent-4,720,139;
US-Patent-Appl-SN-309291; US-Patent-Class-297-216;
US-Patent-Class-188-373; US-Patent-Class-248-548;
US-Patent-Class-248-608) Avail: US Patent and Trademark Office CSCL 13I

An energy absorbing device used as a load limiting member in a structure to control its response to applied loads is described. It functions by utilizing a spool assembly having flanged ends and an interior cavity of sufficiently large diameter to cause it to deform plastically at a prescribed load. In application, the spool is utilized as a pivot point for the legs of an airplane seat. When properly designed and integrated into the seat arrangement the spool will twist about its axis, deforming plastically when the impact load exceeds the spool yield value. Through this deformation, the spool absorbs the kinetic energy of the movement of the seat at a substantially constant rate, thereby controlling the level of loads transmitted to the seat occupant. By proper sizing and collection of materials, it is possible to control load response in a predictable manner.

Official Gazette of the U.S. Patent and Trademark Office

N88-24138# Sira Inst. Ltd., Chislehurst (England). Research and Development Div.
BOTANY FACILITY: MAGNETIC FLUID SEAL CONSIDERATIONS FOR THE CENTRIFUGE
M. A. Cutter *In* MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 6 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP110/MAC004) Copyright Avail: NTIS HC A17/MF A01

N88-24302# Garrett Fluid Systems Co., Tempe, Ariz.
FOIL GAS BEARING SYSTEM ENDURANCE TESTING DYNAMIC ISOTOPE POWER SYSTEM
Keith A. Davis and John F. Ruggles *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 205-208 Sponsored by the Department of the Air Force, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24321# General Electric Co., Philadelphia, Pa. Space Systems Div.
TURBOMACHINERY IN SPACE
T. S. Chan, W. S. Chiu, R. E. Troeger, and M. Shah *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 285-288 (For primary document see N88-24254 17-73)
(Contract F33615-85-C-2544)
Avail: NTIS HC A22/MF A01

N88-24323# Pacific Northwest Labs., Richland, Wash.
DESIGN OF A HIGH-POWER-DENSITY LJUNGSTROEM TURBINE USING POTASSIUM AS A WORKING FLUID
Edmund P. Coomes, Ryan E. Dodge, D. G. Wilson, and S. J. McCabe (Massachusetts Inst. of Tech., Cambridge.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 293-298 (For primary document see N88-24254 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A22/MF A01

N88-24382# Energy Technology Engineering Center, Canoga Park, Calif.
OPTIMIZATION OF SP-100 THERMOELECTRIC ELECTROMAGNETIC PUMP
J. M. Berreth and D. L. Wait *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 33-36 Sponsored by Los Alamos National Lab., N. Mex. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24385*# Sandia National Labs., Albuquerque, N. Mex. Advanced Power Systems Div.
HYDROGEN TURBINES FOR SPACE POWER SYSTEMS: A SIMPLIFIED AXIAL FLOW GAS TURBINE MODEL
Steven L. Hudson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 45-49 Sponsored by NASA, Lewis Research Center, Cleveland, Ohio (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01 CSCL 13I

N88-24429# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
WELDABILITY OF GENERAL PURPOSE HEAT SOURCE IRIDIUM CAPSULES
William R. Kanne, Jr. *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 279-282 (For primary document see N88-24374 17-73)
(Contract DE-AC09-76SR-00001)
Avail: NTIS HC A99/MF A01

N88-24497# New Mexico State Univ., Las Cruces. Dept. of Mechanical Engineering.
ENERGY OPTIMAL TRAJECTORY PLANNING FOR ROBOT MANIPULATORS AND AUTONOMOUS VEHICLES
Richard D. Colbaugh and Keith L. Phillips *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 605-610 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N88-23983*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
METHOD OF RADIOGRAPHIC INSPECTION OF WOODEN MEMBERS Patent Application
Maggie L. Berry, inventor (to NASA) and Robert L. Berry, inventor

(to NASA) 25 Nov. 1987 11 p
(NASA-Case-LAR-13724-1; NAS 1.71:LAR-13724-1; US-Patent-Appl-SN-125678) Avail: NTIS HC A03/MF A01 CSCL 14D

The invention is a method to be used for radiographic inspection of a wooden specimen for internal defects which includes the steps of introducing a radiopaque penetrant into any internal defects in the specimen through surface openings; passing a beam of radiation through a portion of the specimen to be inspected; and making a radiographic film image of the radiation passing through the specimen, with the radiopaque penetrant in the specimen absorbing the radiation passing through it, therby enhancing the resulting image of the internal defects in the specimen. NASA

N88-23984*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AUTOMATICALLY GENERATED ACCEPTANCE TEST: A SOFTWARE RELIABILITY EXPERIMENT Final Report
Peter W. Protzel May 1988 22 p Presented at the 2nd Workshop on Software Testing, Verification and Analysis, Banff, Alberta
(Contract NAS1-18107)
(NASA-CR-181667; ICASE-88-31; NAS 1.26:181667) Avail: NTIS HC A03/MF A01 CSCL 14D

This study presents results of a software reliability experiment investigating the feasibility of a new error detection method. The method can be used as an acceptance test and is solely based on empirical data about the behavior of internal states of a program. The experimental design uses the existing environment of a multi-version experiment previously conducted at the NASA Langley Research Center, in which the launch interceptor problem is used as a model. This allows the controlled experimental investigation of versions with well-known single and multiple faults, and the availability of an oracle permits the determination of the error detection performance of the test. Fault interaction phenomena are observed that have an amplifying effect on the number of error occurrences. Preliminary results indicate that all faults examined so far are detected by the acceptance test. This shows promise for further investigations, and for the employment of this test method on other applications. Author

N88-23985*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH FREQUENCY ULTRASONIC CHARACTERIZATION OF SINTERED SiC
George Y. Baaklini, Edward R. Generazio, and James D. Kiser 1987 19 p Presented at the 11th Annual Conference on Composite and Advanced Ceramic Materials, Cocoa Beach, Fla., 18-23 Jan. 1987; sponsored by the American Ceramic Society
(NASA-TM-100825; E-4013; NAS 1.15:100825) Avail: NTIS HC A03/MF A01 CSCL 14D

High frequency (60 to 160 MHz) ultrasonic nondestructive evaluation was used to characterize variations in density and microstructural constituents of sintered SiC bars. Ultrasonic characterization methods included longitudinal velocity, reflection coefficient, and precise attenuation measurements. The SiC bars were tailored to provide bulk densities ranging from 90 to 98 percent of theoretical, average grain sizes ranging from 3.0 to 12.0 microns, and average pore sizes ranging from 1.5 to 4.0 microns. Velocity correlated with specimen bulk density irrespective of specimen average grain size, average pore size, and average pore orientation. Attenuation coefficient was found to be sensitive to both density and average pore size variations, but was not affected by large differences in average grain size. Author

N88-23986*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
INPUT-OUTPUT CHARACTERIZATION OF FIBER COMPOSITES BY SH WAVES Final Contractor Report
John D. Renneisen and James H. Williams, Jr. Washington NASA Jun. 1988 44 p
(Grant NAG3-328)
(NASA-CR-4153; E-4043; NAS 1.26:4153) Avail: NTIS HC A03/MF A01 CSCL 14D

Input-output characterization of fiber composites is studied theoretically by tracing SH waves in the media. A fiberglass epoxy composite is modeled as a homogeneous transversely isotropic continuum plate. The reflection of an SH wave at a stress-free plane boundary in a semi-infinite transversely isotropic medium is considered first. It is found that an incident SH wave reflects only a similar SH wave back into the medium. It is also established that the angle of reflection of the reflected wave is equal to the angle of incidence of the incident wave. The phase velocity of the SH waves and the delay time of the SH waves in reaching the receiving transducer are computed as functions of a reflection index, defined as the number of reflections of the SH waves from the bottom face of the continuum plate. The directivity function corresponding to the shear stress associated with the SH waves in the continuum plate is also derived as a function of the reflection index. A theoretical output voltage from the receiving transducer is calculated for a tone burst (a periodic input voltage of finite duration). The output voltage is shown for tone bursts of duration 60 microseconds and center frequencies of 0.75, 1.00, and 1.25 MHz. The study enhances the quantitative and qualitative understanding of the nondestructive evaluation (NDE) of fiber composites which can be modeled as transversely isotropic media. Author

N88-23987*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
CHARACTERIZATION OF NONCONTACT PIEZOELECTRIC TRANSDUCER WITH CONICALLY SHAPED PIEZOELEMENT
James H. Williams, Jr. and Simeon C. U. Ochi Washington, D.C. NASA Jun. 1988 88 p
(Grant NAG3-328)
(NASA-CR-4151; E-3995; NAS 1.26:4151) Avail: NTIS HC A05/MF A01 CSCL 14D

The characterization of a dynamic surface displacement transducer (IQI Model 501) by a noncontact method is presented. The transducer is designed for ultrasonic as well as acoustic emission measurements and, according to the manufacturer, its characteristic features include a flat frequency response range which is from 50 to 1000 kHz and a quality factor Q of less than unity. The characterization is based on the behavior of the transducer as a receiver and involves exciting the transducer directly by transient pulse input stress signals of quasi-electrostatic origin and observing its response in a digital storage oscilloscope. Theoretical models for studying the response of the transducer to pulse input stress signals and for generating pulse stress signals are presented. The characteristic features of the transducer which include the central frequency f sub o, quality factor Q, and flat frequency response range are obtained by this noncontact characterization technique and they compare favorably with those obtained by a tone burst method which are also presented. Author

N88-23876*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONDESTRUCTIVE EVALUATION OF STRUCTURAL CERAMICS
Alex Vary *In its* Structural Ceramics May 1986 p 35-46 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 14D

N88-23884*# General Motors Corp., Indianapolis, Ind. Allison Gas Turbine Div.
NONDESTRUCTIVE EVALUATION (NDE) OF STRUCTURAL CERAMICS BY PHOTOACOUSTIC MICROSCOPY
P. K. Khandelwal *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 139-145 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 14D

N88-23886*# Garrett Turbine Engine Co., Phoenix, Ariz.
THERMAL CYCLIC DURABILITY TESTING OF CERAMIC MATERIALS FOR TURBINE ENGINES
L. J. Lindberg *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 163-171 (For primary document see N88-23872 17-27)
(Contract DEN3-27)
Avail: NTIS HC A11/MF A01 CSCL 14D

N88-23887*# Washington Univ., Seattle. Dept. of Materials Science and Engineering.
FRACTOGRAPHIC AND MICROSTRUCTURAL EVALUATION OF 3500-HOUR DURABILITY SPECIMENS
A. D. Miller *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 173-179 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 14D

N88-24491*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FATIGUE FAILURE OF REGENERATOR SCREENS IN A HIGH FREQUENCY STIRLING ENGINE
David R. Hull, Donald L. Alger, Thomas J. Moore, and Coulson M. Scheuermann *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 575-578 Previously announced as N87-18882 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 14D

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N88-23988*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DYNAMIC CHARACTERISTICS OF A VIBRATING BEAM WITH PERIODIC VARIATION IN BENDING STIFFNESS
John S. Townsend Feb. 1987 23 p Previously announced as N87-22726
(NASA-TP-2697; NAS 1.60:2697) Avail: NTIS HC A03/MF A01 CSCL 20K

A detailed dynamic analysis is performed of a vibrating beam with bending stiffness periodic in the spatial coordinate. The effects of system parameters on beam response are explored with a perturbation expansion technique. It is found that periodic stiffness acts to modulate the modal displacements from the characteristic shape of a simple sine wave. The results are verified by a finite element solution and through experimental testing. Author

N88-23989*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRELIMINARY 2-D SHELL ANALYSIS OF THE SPACE SHUTTLE SOLID ROCKET BOOSTERS
Norman F. Knight, Jr., Ronnie E. Gillian, and Michael P. Nemeth Nov. 1987 91 p
(NASA-TM-100515; NAS 1.15:100515) Avail: NTIS HC A05/MF A01 CSCL 20K

A two-dimensional shell model of an entire solid rocket booster (SRB) has been developed using the STAGSC-1 computer code and executed on the Ames CRAY computer. The purpose of these analyses is to calculate the overall deflection and stress distributions for the SRB when subjected to mechanical loads corresponding to critical times during the launch sequence. The mechanical loading conditions for the full SRB arise from the external tank (ET) attachment points, the solid rocket motor (SRM) pressure load, and the SRB hold down posts. The ET strut loads vary with time after the Space Shuttle main engine (SSME) ignition. The SRM internal pressure varies axially by approximately 100 psi. Static analyses of the full SRB are performed using a snapshot picture of the loads. The field and factory joints are modeled by using equivalent stiffness joints instead of detailed models of the joint. As such, local joint behavior cannot be obtained from this global model. Author

N88-23990# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorwerkstoffe.
EFFECT OF TEST SAMPLE GEOMETRY ON THE FATIGUE CRACK GROWTH OF X10NiCrAlTi 32 20 AND NiCr22 Co 12Mo [EINFLUSS DER PROBENGEOMETRIE AUF DAS ERMUEDUNGSRISSWACHSTUM VON X10 NICRALTI 32 20 UND NICR 22 CO 12 MO]
Matthias Pfaffelhuber, Manfred Roedig, Florian Schubert, and Hubertus Nickel Mar. 1988 80 p In GERMAN
(JUEL-Spez-399; ISSN-0343-7639; ETN-88-91929) Avail: NTIS HC A05/MF A01

Tests on the validity for fracture mechanics characteristics of fatigue crack growth at 700 and 800 C were carried out on various specimen geometries, CT1, CT1/2, CCP1/2, and on thick walled tubes for two high temperature resistant nickel alloys: INCOLOY 800H and INCONEL 617. Applied load range was R = 0.05 by 5 Hz frequencies. For the whole range of temperature, the fatigue crack growth is independent of specimen geometry. The linear-elastic delta KI-concept is valid to describe crack propagation under load oscillations. ESA

N88-23991# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
ASYMPTOTICS FOR A SYSTEM OF NONLINEARLY COUPLED WAVE EQUATIONS WITH AN APPLICATION TO THE GALLOPING OSCILLATIONS OF OVERHEAD TRANSMISSION LINES
W. T. vanHorssen 1987 42 p Sponsored by the Netherlands Organization for the Advancement of Pure Research
(Rept-87-78; B8736948; ISSN-0920-8577; ETN-88-92453)
Copyright Avail: NTIS HC A03/MF A01

An asymptotic theory for a class of initial-boundary value problems for systems of weakly, nonlinearly coupled wave equations is presented. The theory implies the well-posedness of the problem in the classical sense and the validity of formal approximations on long time-scales. As an application of the theory an initial-boundary value problem for a system of weakly, nonlinearly coupled wave equations is studied using a two-timescale perturbation method. From an aeroelastic analysis it is shown that this problem may be regarded as a model describing the galloping oscillations of overhead transmission lines in the vertical and in the horizontal direction. ESA

N88-23992# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
A GENERALIZED VARIATIONAL METHOD FOR SOLVING STRESS INTENSITY FACTORS AT CRACKS ON THE EDGE OF HOLES IN ORTHOTROPIC PLATES
De-yu Cui, Pei Gu, Xing Zhang, and G. A. O. Davies (Beijing Inst. of Aeronautics and Astronautics, China) 1987 29 p
(IC-Aero-87-02; ETN-88-92511; ISSN-0308-7247) Avail: NTIS HC A03/MF A01

A generalized variational method (GVM) for the determination of the stress intensity factors (SIF) in orthotropic plates with a symmetric crack emanating from a hole is described. The analysis is based upon the use of the two dimensional theory of anisotropic elasticity to establish stress and displacement series which automatically satisfy all basic equations and boundary condition on the crack surface. By using a generalized variational principle the remaining boundary conditions on the hole are satisfied, and the stress or displacement field as well as SIF are solved. Numerical studies reveal the superior convergence properties and high accuracy obtained using a relatively simple program. The performance of the GVM is compared with predictions given by the finite element method. ESA

N88-23993# Oxford Univ. (England). Dept. of Engineering Science.
BEHAVIOR OF A TWO-LAYERED BEAM UNDER IMPACT LOADING
Yiren Xia 1987 28 p
(OUEL-1716/87; ETN-88-92534) Avail: NTIS HC A03/MF A01

A dynamic model for multilayered beams under impulsive loading, based on Timoshenko beam theory, but which accommodates interlayer slip is proposed. Different impact loads and different interfacial situations are investigated. The transient behavior of a two-layered beam is determined by the characteristic method solution of the dynamic governing equations. The results are found to be in close agreement with the finite element analysis code ABAQUS. ESA

N88-23994*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PARAMETER IDENTIFICATION METHODS FOR IMPROVING STRUCTURAL DYNAMIC MODELS Ph.D. Thesis
Charles Lawrence Jun. 1988 155 p
(NASA-TM-100812; E-3994; NAS 1.15:100812) Avail: NTIS HC A08/MF A01 CSCL 20K

There is an increasing need to develop Parameter Identification methods for improving structural dynamic models, based on the inability of engineers to produce mathematical models which correlate with experimental data. This research explores the efficiency of combining Component Mode Synthesis (substructuring) methods with Parameter Identification procedures in order to improve analytical modeling of structural components and their connections. Improvements are computed in terms of physical stiffness and damping parameters in order that the physical characteristics of the model can be better understood. Connections involving both viscous and friction damping are investigated. Substructuring methods are utilized to reduce the complexity of the identification problem. Component and inter-component structural connection properties are evaluated and identified independently, thus simplifying the identification problem. It is shown that modal test data is effective for identifying modeling problems associated with structural components, and for determining the stiffness and damping properties of intercomponent connections. In general, Parameter Identification is improved when greater quantities of experimental data are available. Author

N88-23995 Purdue Univ., West Lafayette, Ind.
CONTINUUM MODELING AND DYNAMIC ANALYSIS OF LARGE TRUSS STRUCTURES Ph.D. Thesis
Brahim Necib 1987 163 p
Avail: Univ. Microfilms Order No. DA8729772

Truss Structures such as large space structures consist of a large number of truss members. Full scale finite element analysis which accounts for every member is computationally very expensive. In practice only the lower modes of vibration are of interest; the truss structure may be effectively represented by a continuous model. An extended Timoshenko beam model is derived to represent large truss structures where the extensional, flexural and shear deformations are coupled. Procedures for evaluating the equivalent continuum beam stiffnesses based on a substructure of the original system are presented. A higher order beam finite element based on the Timoshenko beam model is developed. Using this model, a number of truss structures is studied for free and forced vibration. Forces in the individual members obtained using the continuum model are compared with the full scale finite element solution applied to the original structure. Experiments are conducted on a scaled down truss model. Strain responses in members of the truss model due to impact force are measured. Comparison of the experimental results and the Timoshenko beam model is very accurate. Dissert. Abstr.

N88-23996 Northwestern Univ., Evanston, Ill.
ANALYSIS OF CRACK-TIP FIELDS IN A VISCOPLASTIC MATERIAL Ph.D. Thesis
Jen-chun Sung 1987 144 p
Avail: Univ. Microfilms Order No. DA8729044

For a stationary crack tip with bounded plastic strain rates, an integral representation which expresses the particle velocity in terms of a Green's function and certain linear combinations of the inelastic strain rates was used. It is shown that the leading term of the near-tip particle velocity is of order r to the one-half and that the higher order terms are of the forms rlogr and r for Mode I case. The rlogr term is absent for the Mode III case. The boundary element method was used to compute the near-tip time dependent stress intensity factors and the normalized opening stress at a small distance ahead of the crack tip. Both decay with time. These two quantities diverge at small values of time. However, the inclusion of a second term in the symptotic expression for the stress gives good agreement over a larger time range. For a transient crack growth case, the finite element method was used to compute the complete stress and strain fields. The numerically computed time-dependent stress intensity factors are presented for several crack-tip speeds. The rise of temperature due to the dissipation of mechanical energy in the vicinity of the crack tip and due to the flux of energy into the propagating crack tip was considered under the adiabatic approximation. Dissert. Abstr.

N88-23997 Kansas Univ., Lawrence.
THREE-DIMENSIONAL CURVED SHELL AND SOLID-SHELL TRANSITION FINITE ELEMENTS WITH TEMPERATURE AND TEMPERATURE GRADIENTS AS PRIMARY VARIABLES FOR STEADY STATE HEAT CONDUCTION Ph.D. Thesis
Robert K. Phillips [1987] 154 p
Avail: Univ. Microfilms Order No. DA8727644

The geometry of the three-dimensional curved shell finite elements is described by coordinates of nodes lying on the shell middle surface and shell normal thickness vectors at these nodes. The element temperature field is defined in terms of element approximation functions, nodal temperatures and nodal temperature gradients through the shell thickness. Thus, in this formulation nodal temperatures as well as nodal temperature gradients are primary variables. This element models linear temperature distributions through the shell thickness. Distributed heat flux and convective heat transfer are permitted on all six element faces. The element is also capable of modeling internal heat generation and materials with orthotropic thermal conductivity. The element performance was demonstrated with numerical examples and comparisons were made with theoretical and two-dimensional solutions. The solid-shell transition finite elements were developed to facilitate the connection of solid elements to the curved shell elements. These transition elements permit transition from solid elements in the solid-like region of the structure to shell elements in the shell-like region. Dissert. Abstr.

N88-23998*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MECHANICS OF INSTABILITY-RELATED DELIMINATION GROWTH
John D. Whitcomb May 1988 26 p
(NASA-TM-100622; NAS 1.15:100622) Avail: NTIS HC A03/MF A01 CSCL 20K

Local buckling of a delaminated group of plies can lead to higher interlaminar stresses and delamination growth. The mechanics of instability-related delamination growth (IRDG) had been described previously for the through-width delamination. This paper describes the mechanics of IRDG for the embedded delamination subjected to either uniaxial or axisymmetric loads. The mechanics of IRDG are used to explain the dramatic differences in strain-energy release rates observed for the through-width, the axisymmetrically loaded embedded delamination, and the uniaxially loaded embedded delamination. Author

N88-23999*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, Calif.
A COMPARISON OF EXPERIMENTAL AND CALCULATED THIN-SHELL LEADING-EDGE BUCKLING DUE TO THERMAL STRESSES
Jerald M. Jenkins Jul. 1988 17 p

(NASA-TM-100416; H-1440; NAS 1.15:100416) Avail: NTIS HC A03/MF A01 CSCL 20K

High-temperature thin-shell leading-edge buckling test data are analyzed using NASA structural analysis (NASTRAN) as a finite element tool for predicting thermal buckling characteristics. Buckling points are predicted for several combinations of edge boundary conditions. The problem of relating the appropriate plate area to the edge stress distribution and the stress gradient is addressed in terms of analysis assumptions. Local plasticity was found to occur on the specimen analyzed, and this tended to simplify the basic problem since it effectively equalized the stress gradient from loaded edge to loaded edge. The initial loading was found to be difficult to select for the buckling analysis because of the transient nature of thermal stress. Multiple initial model loadings are likely required for complicated thermal stress time histories before a pertinent finite element buckling analysis can be achieved. The basic mode shapes determined from experimentation were correctly identified from computation. Author

N88-24000*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STRUCTURES AND DYNAMICS DIVISION RESEARCH AND TECHNOLOGY PLANS FOR FY 1988 AND ACCOMPLISHMENTS FOR FY 1987
Kay S. Bales May 1988 94 p
(NASA-TM-100585; NAS 1.15:100585) Avail: NTIS HC A05/MF A01 CSCL 20K

Presented are the Objectives, FY 1988 Plans, Approach, and FY 1988 Milestones for the Structures and Dynamics Division (Langley Research Center) research programs. FY 1987 Accomplishments are presented where applicable. This information is useful in program coordination with other governmental organizations in areas of mutual interest. Author

N88-24001*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPLICATION OF INTEGRATED FLUID-THERMAL-STRUCTURAL ANALYSIS METHODS
Allan R. Wieting, Pramote Dechaumphai, Kim S. Bey, Earl A. Thornton, and Ken Morgan (Wales Univ., Swansea.) May 1988 13 p Prepared for presentation at the 16th Congress of the International Council of the Aeronautical Sciences, Jerusalem, Israel, 28 Aug. - 2 Sep. 1988
(NASA-TM-100625; NAS 1.15:100625) Avail: NTIS HC A03/MF A01 CSCL 20K

Hypersonic vehicles operate in a hostile aerothermal environment which has a significant impact on their aerothermostructural performance. Significant coupling occurs between the aerodynamic flow field, structural heat transfer, and structural response creating a multidisciplinary interaction. Interfacing state-of-the-art disciplinary analysis methods is not efficient, hence interdisciplinary analysis methods integrated into a single aerothermostructural analyzer are needed. The NASA Langley Research Center is developing such methods in an analyzer called LIFTS (Langley Integrated Fluid-Thermal-Structural) analyzer. The evolution and status of LIFTS is reviewed and illustrated through applications. Author

N88-24002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENGINE STRUCTURES: A BIBLIOGRAPHY OF LEWIS RESEARCH CENTER'S RESEARCH FOR 1980-1987
Apr. 1988 212 p Compiled by the Committee for LST 88, the Lewis Structures Technology Symposium and Exposition, Cleveland, Ohio, 24-25 May 1988
(NASA-TM-100842; E-4033; NAS 1.15:100842) Avail: NTIS HC A01/MF A01 CSCL 20K

This compilation of abstracts describes and indexes the technical reporting that resulted from the scientific and engineering work performed and managed by the Structures Division of the NASA Lewis Research Center from 1980 through 1987. All the publications were announced in the 1980 to 1987 issues of STAR (Scientific and Technical Aerospace Reports) and or IAA (International Aerospace Abstracts). Included are research reports, journal articles, conference presentations, patents and patent applications, and theses. Author

N88-23877*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRACTURE MECHANICS
John L. Shannon, Jr. *In its* Structural Ceramics May 1986 p 47-57 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 20K

N88-23878*# Washington Univ., Seattle. Brittle Materials Design Program.
STRUCTURAL CERAMICS RESEARCH
J. I. Mueller, R. J. H. Bollard, and R. C. Bradt *In* NASA, Lewis Research Center, Structural Ceramics May 1986 p 59-62 (For primary document see N88-23872 17-27)
Avail: NTIS HC A11/MF A01 CSCL 20K

N88-23898*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NON-CONTACT TEMPERATURE MEASUREMENT REQUIREMENTS FOR ELECTRONIC MATERIALS PROCESSING
S. L. Lehoczky and F. R. Szofran *In* NASA, Washington, D.C. Noncontact Temperature Measurement Mar. 1988 p 67-78 (For primary document see N88-23895 17-29)
Avail: NTIS HC A19/MF A01 CSCL 22A

N88-24468# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
EXPERIMENTAL INVESTIGATION OF A MICROGRAVITY SEPARATOR FOR TWO PHASE MIXTURES CONTAINING SMALL VOLUMES OF GAS/VAPOR
Vladimir M. Valentekovich and Vijay K. Dhir *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 457-460 Sponsored in part by Southern California Edison Co., Los Angeles (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

42 GEOSCIENCES (GENERAL)

N88-24003# Meteorological Satellite Center, Tokyo (Japan).
METEOROLOGICAL SATELLITE CENTER TECHNICAL NOTE NO. 16
1988 95 p In ENGLISH and JAPANESE
(ISSN-0388-9653) Avail: NTIS HC A05/MF A01

Articles addressing the utilization and analysis of satellite-derived meteorological data are presented. Specific topics include: satellite wind-sensing systems, estimation of outgoing longwave radiation, image and data processing, cloud classification, open cells associated with warm advection, and sea ice imaging. For individual titles, see N88-24004 through N88-24011.

N88-24004# Meteorological Satellite Center, Tokyo (Japan).
PROSPECTS OF SATELLITE WIND SENSING SYSTEMS IN THE YEARS 1995-2000 **c18**
Tadaaki Hamada *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 1-8 Presented at the Workshop on Space Systems Possibilities for Global Energy and Water Cycle Experiment, Columbia, Md., 19-23 Jan. 1987 (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

One of the main observational requirements of the Global Energy and Water Cycle Experiment (GEWEX) is tropical wind data. The prospects of spaceborne wind sensing systems for the 1995 to 2000 period are summarized. The most promising areas of development are: (1) continuous operation of current cloud motion wind (CMW) derivation systems from geostationary satellites, (2) ocean surface wind derivation from microwave

scatterometers onboard polar orbital meteorological satellites, and (3) new active sensing instruments such as the Doppler lidar system. Author

N88-24005# Meteorological Satellite Center, Tokyo (Japan).
LATITUDINAL AND SEASONAL VARIATION OF THE CLOUD CHARACTERISTIC PARAMETERS AND THEIR EFFECTS ON THE CLOUD CLASSIFICATION **c47**
Tadashi Aso, Kazuhiro Oosawa, and Yoshiaki Takeuchi *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 9-20 (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

Latitudinal and seasonal trends of variation of cloud characteristic parameters and the effects on objective cloud classification are investigated using an accumulated histogram derived from Geostationary Meteorological Satellite (GMS) infrared and visible spectrum imagery. The cloud features of nine specified cloud classes were studied separately. Definite tendencies in the latitudinal and seasonal variations of two main cloud parameters, cloud top temperature and maximum albedo, were found. These variations result in a systematic failure in cloud classification. A large decrease in the accuracy of classification occurs in winter and is caused by the latitudinal variation of cloud top air temperature and the low solar zenith angle. It is noteworthy that the albedo data in both summer and winter have an identical linear relationship suggesting that thick clouds have almost the same albedo in summer and winter. One simple method for removing the influence of these variations on cloud classification is to calculate discriminant coefficients in each latitude zone. Author

N88-24006# Meteorological Satellite Center, Tokyo (Japan).
ESTIMATION OF TOTAL OUTGOING LONGWAVE RADIATION (OLR) FLUX FROM GEOSTATIONARY METEOROLOGICAL SATELLITE INFRARED WINDOW RADIANCE **c46**
Toshiyuki Kurino and Akihiro Uchiyama *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 21-32 (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

Total outgoing longwave radiation (OLR) flux, thermally emitted from the earth-atmosphere system, was estimated by applying linear regression equations relating OLR flux with Geostationary Meteorological Satellite (GMS) infrared window radiance. The coefficients of the regression equations were determined from the results of radiative transfer model simulation with various atmospheric conditions. OLR radiances were calculated for 140-divided longwave spectral intervals with 140 atmospheric conditions at eight zenith angles. A rather high correlation ($R = 0.971$) was found between the total OLR flux from radiative transfer calculations and estimated ones from GMS infrared window radiance, although there were low correlation regions corresponding to absorption bands (e.g., water, vapor, carbon dioxide, ozone). Author

N88-24007# Meteorological Satellite Center, Tokyo (Japan).
OUTLINE OF THE GPCP STRATEGY **c46**
Toshiyuki Kurino *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 33-38 In JAPANESE; ENGLISH summary (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

The Meteorological Satellite Center (MSC) has been producing Geostationary Meteorological Satellite (GMS) infrared radiance statistics on an operational basis since March 1984 and has been providing those data to the Global Precipitation Climatology Project (GPCP) on a routine basis. This report describes the strategy of GPCP and the role of MSC as one of the data processing centers for geostationary meteorological satellites. Author

N88-24008# Meteorological Satellite Center, Tokyo (Japan).
VISSR LINE NUMBER MONITORING SYSTEM **c61**
Masaaki Sugai and Toshio Onigata *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 39-47 In JAPANESE; ENGLISH summary (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

A system for monitoring the GMS-3 Visible/Infrared Spin-Scan Radiometer (VISSR) line number using a personal computer system with general purpose interface boards is described. The system allows the easy recording and accumulation of data from the VISSR mirror's steps and allows one to analyze disorders without difficulty. A configuration of the monitoring system is described. Author

N88-24009# Meteorological Satellite Center, Tokyo (Japan).
SOME PROBLEMS WITH REGARD TO THE TOVS PROCESSING DETECTED BY USING NOAA-HRPT DATA CHECK PROGRAM **c61**
Yoshiaki Takeuchi *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 49-58 In JAPANESE; ENGLISH summary (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

The image and calibration data that are included in some original High Resolution Picture Transmission (HRPT) data sets are investigated by using a newly prepared HRPT check program. The results with regard to the Tiros Operational Vertical Sounder (TVOS) processing at the Meteorological Satellite Center (MSC) are the following: (1) the fluctuation of the difference between a HRPT time code and a Tiros Information Processor (TIP) time code can not be disregarded in calculating the latitude and longitude of a High Resolution Infrared Sounder (HIRS) spot; (2) a detailed calibration of Advanced Very High Resolution Radiometer Ch.4 and Microwave Sounding Unit data verify the calibration method that is carried out presently at MSC; and (3) regular noise in HIRS Ch.1 and random noise in Stratospheric Sounding Unit data are detected. Author

N88-24010# Meteorological Satellite Center, Tokyo (Japan).
OPEN CELL ASSOCIATED WITH WARM ADVECTION **c47**
Kazufumi Suzuki *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 59-69 In JAPANESE; ENGLISH summary (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

Open cells were investigated in the vicinity of Japan for two winter seasons and were classified into two types, COC (cold air type open cell) and WOC (warm advection type open cell). COC is observed in the cold air mass and is organized in agreement with the open cell generating mechanism proposed by many other studies. WOC is observed in warm advection and occurence of WOC is rare. The characteristics of WOC are very different from COC and have the following properties: (1) transforming from stratocumulus (closed cell) into cumulus (open cell); (2) presence of synoptic scale upward motion; (3) temperature rising by 1 to 6 C through the lower layers; (4) accompanying strong wind with southern wind component; and (5) weak flux from the sea to the atmosphere (air-sea temperature difference of 8.5 C). Author

N88-24011# Meteorological Satellite Center, Tokyo (Japan).
ENHANCED INFRA-RED PICTURE OF LR-FAX FOR SPRING AND AUTUMN SEASONS **c43**
Saya Kurino *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 75-79 In JAPANESE; ENGLISH summary (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

The enhanced infrared images, which are presently disseminated as one of LR-FAX (Low Resolution Facsimile), are not suitable for expressing the cloud distributions in spring and autumn. A conversion table prepared for these two seasons has been applied to the operation of LR-FAX J pictures since March 15, 1987. Author

N88-24012*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CHEMICAL KINETICS AND PHOTOCHEMICAL DATA FOR USE IN STRATOSPHERIC MODELING EVALUATION NUMBER 8
W. B. DeMore, M. J. Molina, S. P. Sander, D. M. Golden, R. F. Hampson, M. J. Kurylo, C. J. Howard, and A. R. Ravishankara (National Oceanic and Atmospheric Administration, Boulder,

Colo.) 15 Sep. 1987 205 p
(Contract NAS7-918)
(NASA-CR-182919; JPL-Publ-87-41; NAS 1.26:182919) Avail: NTIS HC A10/MF A01 CSCL 04A

This is the eighth in a series of evaluated sets of rate constants and photochemical cross sections compiled by the NASA Panel for Data Evaluation. The primary application of the data is in the modeling of stratospheric processes, with particular emphasis on the ozone layer and its possible perturbation by anthropogenic and natural phenomena. Copies of this evaluation are available from the Jet Propulsion Laboratory, Documentation Section, 111-116B, California Institute of Technology, Pasadena, California, 91109. Author

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N88-24013# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
LATIN AMERICAN SYMPOSIUM ON REMOTE SENSING. 4TH BRAZILIAN REMOTE SENSING SYMPOSIUM AND 6TH SELPER PLENARY MEETING, VOLUME 1
1986 798 p In PORTUGUESE; ENGLISH summary Symposium held in Gramado, Brazil, 10-15 Aug. 1986 Prepared in cooperation with Sociedad de Especialistas Latinoamericanos en Percepcion Remota, Chile, and Sociedade Brasileira de Cartografia, Geodesia, Fotogrametria e Sensoriamento Remoto
Avail: NTIS HC A99/MF E03

Topics addressed include: crop cover estimation; rain penetration; forest resources in Uruguay; geometric correction of data; satellite imagery; thematic mapping; surface morphology; spatial filtering; remote sensing problems; image classifications; remote sensing; geographical information systems; computer techniques; spectral behavior of crops; tectonics; data processing; cartography; image processing; archeology; aerial photography; geological structures. For individual titles, see N88-24014 through N88-24100.

N88-24014# Silsoe Coll., Bedford (England).
A COMPARISON OF SUPERVISED MAXIMUM LIKELIHOOD AND DECISION TREE CLASSIFICATION FOR CROP COVER ESTIMATION FROM MULTITEMPORAL LANDSAT MSS DATA
A. S. Belward and A. DeHoyos (Oxford Univ., England) *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Sumposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 9 Previously announced in IAA as A87-35312 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A case study, where multitemporal LANDSAT MSS data are used for crop cover classification, was used to compare standard supervised maximum likelihood with a simpler supervised binary decision tree based on coincident spectral plots. The results show clear improvements in overall accuracy by using the decision tree. IAA

N88-24015*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RADAR PENETRATION IN THE AMAZONIAN RAIN FOREST Abstract Only
Roberto PereiradaCunha (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil) and John Ford *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 58 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Radar return from vegetation covered terrains is due to three components: the scattering resulting from the top surface of the vegetation canopy (surface scattering); the scattering which occurs within the vegetation layer (volume scattering); and the scattering which takes place at the surface below the vegetation canopy (ground scattering). Through the studies of selected areas in the Amazon Region a case is presented where most of the radar returns observed in radar imagery results from the scattering at the surface below vegetation layer (ground scattering). Thus, radar penetration occurred. Author

N88-24016# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A PROPOSAL FOR A PROJECT ENTITLED ASSESSMENT OF FOREST RESOURCES IN URUGUAY SUBMITTED TO THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION (UNIDO) Abstract Only
Rene Antonio Novaes, David Chung Liang Lee, Pedro Hernandez Filho, Armando PachecodosSantos, and Flavio Jorge Ponzoni *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 59 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The main objective of this project is to collect basic forest information for the development, promotion, and utilization of alternative sources of energy through the use of national resources, and to determine the value of LANDSAT-TM data as an aid in efficient management of Uruguay's plantations. An additional objective is to train a Uruguayan technical team. Indications are given as to how each task will be accomplished and what techniques will be employed in performing main tasks such as: forest mapping and development of the map legends; map accuracy assessment and forest area correction; stand timber volume evaluation; and field sampling and mensuration procedures. In addition, information was included concerning: project flow diagram; activity bar diagrams; and equipment required for task accomplishment. The required specific results of maps and timber volumes were mentioned. Author

N88-24017# Societe Europeenne de Propulsion, Bordeaux (France). Image Processing Div.
THE GEOMETRIC WORKSTATION, A NEW APPROACH FOR GEOMETRIC CORRECTIONS OF REMOTELY SENSED DATA Abstract Only
P. N. Pascaud and Ph. Rebillard *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 69 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Accurate registration of image data to maps or image-to-image is mandatory for both cartographic and multitemporal or multisensor studies. The auxiliary data provide with the images do not allow a satisfactory precision level in the image production. The magnitude of the errors vary with the sensors and can be greater than a hundred pixels. If a better precision is needed, additional information such as pairs of ground control points (GCP) must be introduced. Acquisition of such sets of control points is usually a difficult and tiresome repetitive task. The geometric workstation overpasses some typical limitations of existing methods. An interactive software was designed in order to improve efficiency of the operators. The systematic access to the map sheet was suppressed by digitally storing the maps and retrieving them using a cartographic data base service. An automatic recognition of the GCP is provided by the data base. A sophisticated signal processing was implemented in order to improve the quality of the auxiliary data. The combination of all these features allows the geometric workstation to perform quick and efficient geometric corrections. This improved precision is fully exploited by the accurate algorithm used for geometric precision modeling. Author

N88-24018# MacDonald, Dettwiler and Associates Ltd., Richmond (British Columbia).
MAPPING FROM LANDSAT AND SPOT SATELLITE IMAGERY Abstract Only

Ian Laverty *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 70 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Recent advances in the resolution and stereo capability of earth imaging satellites have made it practical to produce true cartographic maps from satellite imagery. Preliminary tests with LANDSAT TM have shown that: satellite imagery can be corrected to planimetric accuracy suitable for 1:50,000 scale maps with very few control points. Elevation can be derived accurately from stereo satellite imagery by automatic computer processing. Natural planimetric features can be interpreted accurately enough for 1:50,000 scale mapping at 30 meter resolution. The results from SPOT imagery, particularly in the areas of elevation accuracy and the interpretation of cultural features where LANDSAT TM does not meet 1:50,000 scale mapping standards are updated. An operational method of producing and updating topographic base maps digitally from satellite imagery will be presented. The costs and benefits of satellite mapping, particularly for developing nations, will be discussed in detail. Author

N88-24019# Toulouse Univ. (France). Langages et Systemes Informatiques.
THE SYSTEME D'ANALYSE GEOGRAPHIQUE (SAGE) GEOGRAPHIC ANALYSIS SYSTEM Abstract Only
M. R. Caubet and M. A. Hameurlain *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 86 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The design and implementation of a geographic analysis system, SAGE, is described. A classification of geographic analysis data base queries and two geographic data manipulation models are presented. Then, after establishing a data base model for geographic objects, a series of integrity constraints on the time and space elements of the geographic data base are specified and a means of ensuring the structural coherence of geographic objects is discussed. Author

N88-24020# Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
SPECTRAL MEASUREMENTS FOR CORRECTING LANDSAT DATA FOR ATMOSPHERIC EFFECTS Abstract Only
A. Brizuela, M. A. Raed, G. Herren, and C. Marinez Casado *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 92 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Target reflectance data are needed by all man and machine systems to obtain the unambiguous interpretation of LANDSAT data. In response to the need for correcting target reflectance spectral data, the capabilities of a wide range of techniques for determining and removing atmospheric parameters and effects from LANDSAT data are being evaluated. Evaluated techniques include: experimental method that includes transferring known ground reflectance to spacecraft measurements, and three empirical methods computerizing image processing techniques. The approach that was performed was the conversion of radiance data from the satellite into reflectance values from a measurement technique based on ground measurements with an Exotech Model 100 A radiometer. Two Chavez' techniques are used to correct ERTS digital data for atmospheric scattering and other associated haze effects. Another empirical method is an extension of Chavez' Regression Technique: the covariance matrix method (CMM) for estimating additive path radiance in remote sensing data. All the methods were applied to each LANDSAT image of Buenos Aires and its environment. It was concluded that in all cases, there is a big influence of path radiance with different high levels and with time. Another important conclusion was obtained: there is a high correlation between histogram minimum load and CMM empirical methods with ground data. Empirical methods are of the same order as the ground truth haze effects. Author

N88-24021*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AIRBORNE AND SPACEBORNE RADAR IMAGES FOR GEOLOGIC AND ENVIRONMENTAL MAPPING IN THE AMAZON RAIN FOREST, BRAZIL Abstract Only
John P. Ford and James J. Hurtak (Technological Marketing Analysis Corp., San Francisco, Calif.) *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1, 1986 p 129 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Spaceborne and airborne radar image of portions of the Middle and Upper Amazon basin in the state of Amazonas and the Territory of Roraima are compared for purposes of geological and environmental mapping. The contrasted illumination geometries and imaging parameters are related to terrain slope and surface roughness characteristics for corresponding areas that were covered by each of the radar imaging systems. Landforms range from deeply dissected mountain and plateau with relief up to 500 m in Roraima, revealing ancient layered rocks through folded residual mountains to deeply beveled pediplain in Amazonas. Geomorphic features provide distinct textural signatures that are characteristic of different rock associations. The principle drainages in the areas covered are the Rio Negro, Rio Branco, and the Rio Japura. Shadowing effects and low radar sensitivity to subtle linear fractures that are aligned parallel or nearly parallel to the direction of radar illumination illustrate the need to obtain multiple coverage with viewing directions about 90 degrees. Perception of standing water and alluvial forest in floodplains varies with incident angle and with season. Multitemporal data sets acquired over periods of years provide an ideal method of monitoring environmental changes. Author

N88-24022# Technological Marketing Analysis Corp., San Francisco, Calif.
SUBSURFACE MORPHOLOGY AND GEOARCHAEOLOGY REVEALED BY SPACEBORNE AND AIRBORNE RADAR Abstract Only
J. J. Hurtak *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1, 1986 p 130 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The Shuttle Imaging Radar (SIR-A) aboard the Space Shuttle Columbia penetrated the extremely dry deserts of the eastern Sahara, revealing previously unknown buried valleys, geologic structures, and possible Stone Age occupation sites, not detectable by LANDSAT. Radar responses from bedrock and gravel surfaces were also able to provide information in areas covered by very dry sand up to a depth of six meters. The enhancement of many geologic structures and the delineation of adjunct units partly mantled by sand, make the SIR-A a valuable adjunct of conventional geographic mapping tools. The use of radar imaging to determine the subsurface fluvial features in southern Egypt and Sudan is compared with the detection of subsurface stream canals in the tropical terrain of Guatemala-Belize. Radar penetraion of tropical vegetation and soil varies with the wavelength of the incident signals. Subsurface features with potential tectonic or geomorphic significance may also be revealed in other orbital radar. The CV 990 imaging of tropical terrain detected the presence of an extensive canal drainage network beneath the jungle cover of Guatemala, providing the specific geologic locations of landforms which were sites of episodic human habitation. Radar imagery represents a large-scale of perspective of providing extensive information improving both the quality and quanity of subsurface morphology and geoarcheaology targets through penetration of foliage, silt, and root cover to map ancient man-made roads, causeways, and natural signatures disclosing the larger environmental design. Author

N88-24023# Silsoe Coll., Bedford (England).
MAPPING SOIL AND ROCK VARIATION FROM SATELLITE IMAGES IN THE SAHEL Abstract Only
John Taylor, Alan Belward, David Hewitt, and Barry Wyatt *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 131 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The use of the Soil Brightness Index (SBI) for mapping soil and rock variation in arid and semi-arid conditions with partial vegetation cover was investigated. The test site was near Kao in the Sahelian pasturelands of the Republic of Niger. Field visits were undertaken to characterize the range of cover types in the study area and to establish training areas which could be located on LANDSAT 5 MSS imagery. The main rock types were laterites in easily identifiable outcrops. Soils consisted of fractured laterite close to the outcrops progressing through various mixtures of clay outwash with laterite gravel to clay outwash furtherest from the outcrop. Spectral reflectance measurements of surface soils, rocks, and vegetation were made in the field using a portable seven-band radiometer. The relationship between reflectances of the bare soil and rock categories in the red and infrared wavebands was determined by linear regression. The equation of the soil line for the MSS image was used to calculate a transform equation to calculate the value of the SBI for each pixel of the Kao test area. Author

N88-24024# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
COMPARISON OF SURFACE CURRENT DETERMINED FROM SATELLITE-TRACKED BUOY WITH SHIPBOARD WIND DATA DURING THE 4TH BRAZILIAN ANTARCTIC EXPEDITION, 10-14 MARCH, 1986 **c48**
Merritt R. Stevenson, Eduardo M. B. Alonso, Carlos L. DaSilva, Jr., and Reinaldo Solewicz *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SEELPER Plenary Meeting, Volume 1986 1 p (For primary document see PER Plenary Meeting, Volume 1 p 181 (SEE N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A drifting buoy developed by INPE was launched on the 10th of March and tracked by the system ARGOS, using NOAA-6 and NOAA-9 satellites until the 14th of March, when the buoy was recovered by the oceanographic support ship Barao de Teffe. After the launch of the buoy, a set of oceanographic stations was occupied at which time wind measurements were made from the ship. Other wind measurements were also made at hourly intervals, and combined with station winds to form a times series for the experiment. Prior to and at the time of buoy launch, the wind was from the SW and parallel to the axis of the Strait. During the following 8 hours, winds were weak or calm. Afterward the wind changed direction and blew from the NE with speeds increasing to more than 30 knots and gusts to 48 knots during the following day. Wind continued strong and generally from the NE and E until the 14th of March when the buoy was recovered. During the experiment about 40 buoy positions were determined by service ARGOS in Toulouse, France. A comparison was made of the wind and buoy trajectories in terms of time lag. Author

N88-24025# Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Geofisica.
SPATIAL FILTERING ON DIGITAL IMAGES Abstract Only
J. Lira and M. Chavez *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 151 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Digital filtering of spatial features has many applications upon digital images derived from remote sensors. The applications are as diverse as noise removal, smoothing techniques, restoration, and evaluation of morphologic parameters of spatial patterns. As far as remote sensing is concerned, this kind of filtering has direct consequences on geomorphology related to tectonic modeling and natural resources exploration. A formalization of spatial filtering and spatial correction filtering, using a window without going into the frequency domain, is given. A comparison of this approximation with the filtering through the Fast Fourier Transform is established, giving in each case a computational performance and the explicit dependence of the cut-off frequency with the related parameters involved in the filtering. A set of possible applications in different areas of experimental research is also given. Author

N88-24026# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Ministerio da Ciencia e Tecnologia.
A PROPOSAL OF ADAPTATION OF A KNOWLEDGE-BASED SCENE ANALYSIS MODEL TO SOME REMOTE SENSING PROBLEMS Abstract Only
Paulo Ouvera Simoni *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 151 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A scene analysis computer program, developed according to an AI paradigm, is described through its representational and control components. The available declarative knowledge about a domain or process can be stored in a particular type of associative network, in the form of concepts, part and particularization hierarchies, predicate calculus-like formulas and decision rules. Procedural knowledge can also be supplied in many forms, as codes associated to attributes and predicates, actions to be performed after concept activation and control affecting heuristics. Control can be viewed as a series of propagation of alterations, problem solving and image measurement steps. The necessary adaptations to be performed over this program in order to store knowledge from experts on some remote sensing and image analysis problems are discussed. Some of these problems are related to the analysis of geologic sites, map guided interpretation and knowledge-based segmentation. Author

N88-24027# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TEXTURAL FEATURES FOR IMAGE CLASSIFICATION IN REMOTE SENSING Abstract Only
Vitor Haertel (Rio Grande do Sul Univ., Porto Alegre, Brazil) and Yosio E. Shimabukuro *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 181 Previously announced as N88-16181 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Texture is an important characteristic in identifying regions of interest in an image. Several methods to quantify image texture were reported in the literature. Experiments are described which are aimed at extracting textural features from digital images by calculating statistical properties in and around each pixel. The moving window concept is implemented and tests using LANDSAT MSS and TM imagery are presented. Author

N88-24028# Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
SHAPE DETECTION IN REMOTE SENSING THROUGH GRAPH ISOMORPHISM Abstract Only
Severino Fernandez *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 183 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Experiments on shape detection in remote sensing were performed using graph homeomorphism as the match criteria. The first step involved is to extract a graph from a monochromatic image, being the first approach the extraction of linear features as graph edges and intersections and points of local maximum curvature as graph nodes. This first step was performed through three consecutive algorithms: detection of edge strength and thresholding with the Vero-Massy algorithm, edge thinning and

finally edge following with simultaneous graph destruction generation. This provides a description of the considered image as a set of graphs. The description is completed with the computation of the angle between graph edges incident at a common node. A candidate graph is now generated and the same description is computed. The graph matching procedure is carried out with a simplified version of a forward checking with backtracking algorithm from Haralick and Shapiro with the sum of differences between corresponding edges of prototype and candidate as a measure of graph similarity. Finally, a couple of experiments with LANDSAT images is shown. Author

N88-24029# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE MODELING OF ERROR BUDGET ANALYSIS AND TOLERANCE SPECIFICATIONS FOR BRESEX MULTIBAND LINEAR ARRAY CCD CAMERA Abstract Only
G. K. Rayalu *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 254 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

In multispectral imaging, precise image-to-image registration is necessary to form a color composite. The accuracy to which images may be registered depends on many factors. Achieving a half-a-pixel registration error between corresponding elements of any two bands in an involved task and calls for stringent specifications on various sub-systems of a camera. An attempt is made to present what are the sources of error, how to distribute them on a RMS basis to achieve a given total registration error and derive tolerance specifications for the sub-system components and for the alignment of the BRESEX camera. The final error budget is checked for its practicability, considering various options and making full use of the available state-of-the-art technology. Author

N88-24030# Paraiba Univ., Joao Pessoa (Brazil).
INDENTIFICATION OF SHALLOW GROUNDWATER REGIONS IN SEMI-ARID BRAZIL BY REMOTE SENSING METHODS Abstract Only
S. V. Kameswara Sarma *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 p257 (SEE N88-24013 17-43) 1986 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Employing remote sensing techniques for identifying regions with shallow groundwater depths is a recent advance reported by Menenti (1984). In semi-arid and arid regions, the evaporation can be reliably determined by soil balance methods. A rugged crust overlying a 20 cm deep groundwater table or a smooth hard, very dry soil surface overlying a 1 m deep water table are examples that can be cited to establish the efficacy of this method. However, initial calibration by a thermal infrared radiometer or a neutron probe of ground reference points would be necessary to establish the required relationships for the interpretation of the data. The field data from observed piezometric heads would help in finding the detailed groundwater flow pattern. The large daily amplitudes of surface temperatures observed in soft friable surfaces where groundwater discharge occurs is taken advantage of in predicting the shallow groundwater regions. Using the soil water flow simulation model SWATR, relationships between shallow groundwater depth and ratio of actual to potential evaporation could be obtained. The potentially useful role of remotely sensed data to study the soil layering, surface energy balance, and evaporation of semi-arid and arid regions of north-east Brazil is stressed. Author

N88-24031# Purdue Univ., West Lafayette, Ind. Dept. of Geosciences.
AN INTEGRATED STUDY OF THE ALTO PARANAIBA KIMBERLITE PROVINCE, MINAS GERAIS, BRAZIL: A POSSIBLE TOOL FOR DIAMOND EXPLORATION Abstract Only
Arvind Chaturvedi *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 258-259 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The initial results from an integrated study of the Alto Paranaiba area utilizing remote sensing, geophysical, and geological data are presented. The Alto Paranaiba area is economically important due to the local occurrences of kimberlite and diamonds. Kimberlites in the area are confined to a narrow NW-SE oriented strip of Precambrain metasediments and occur as diatremes and dikes. Visual imterpretation of LANDSAT MSS imagery permits the delineation of the regional geology and structure of the Alto Paranaiba area. The Precambrain metasediments are easily distinguished from each other based on photo-recognition criteria. Analysis of an X-band SLAR mosaic facilitates a more detailed interpretation of the geology and structure in the vicinities of Coromandel, Monte Carmelo, and Patrocinio where most of the known kimberlites appear to be concentrated. Subtle linear and circular features, not seen on LANDSAT MSS imagery, are expressed clearly on the SLAR mosaic because of the increased resolution, look direction, and larger scale. Initial results indicate that some circular and linear features appear to be related to the known kimberlites in the area. However, several circular features, located near fractures and or fracture intersections, are not shown on previously published geological maps of the area and need to be investigated in greater detail. Author

N88-24032# Silsoe Coll., Bedford (England).
SATELLITE REMOTE SENSING OF TURBIDITY AND SEDIMENT CONCENTRATION IN LAGOA DOS PATOS Abstract Only
John Taylor, Vipul Patel, Alan Belward, Lawson Beltrame, and Marley Goncalves (Rio Grande do Sul Univ., Porto Alegre, Brazil) *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 279 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The use of LANDSAT Multispectral Scanner (MSS) digital imagery for mapping water turbidity and suspended sediment in Lagoa dos Patos, Rio Grande do Sul was investigated. Field measurements were taken form vessels in a test area, Saco De Tapes when there was a satellite overpass. Sample site locations were determined from shore-based fixes on the boats at the time of each reading. The satellite image was geometrically corrected and the sampling sites were located on it. Regression models were developed between LANDSAT digital data and field measurements. The results indicated that turbidity was linearly related to the spectral responses in MSS bands 1 and 2. The best relationship for the available data was with band 2. Suspended sediment concentration and turbidity were also linearly related using data from additional sampling data. Land and water features on the image were separated by masking. Band 2 of the satellite image of water surfaces was digitally smoothed to remove noise and then interactively density sliced. The regression equations were applied to determine the turbidity and suspended sediment levels for each slice. The results encourage the belief that satellite images can be used to quantatively map the spatial distribution of turbidity and suspended sediment in Lagoa dos Patos. It was possible to identify as sources of clear or tubid water all of the streams flowing into the test area. Author

N88-24033# Indian Association for the Cultivation of Science, Calcutta.
LANDUSE AND LANDFORM STUDIES OF THE MAHANADI RIVER DELTA WITH THE HELP OF SATELLITE MSS BAND Abstract Only
Ranjit Kumar Banerjee *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 291 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The present study is confined to the lower course of the Mahanadi River after the Satkosia Gorge. The Mahanadi River is on of the major rivers of the northern peninsular India which drains into the Bay of Bengal. Four major landforms are identified: residual hill termed highlands; intermediate lands; lowlands; and flood plains. The area is under the influence of deltaic environment and coastal vegetation is confined to the swampy areas with a big lake nearby known as Chilka Lake. Transport facility is meager in comparison with the industrial region near Cuttackand Bhubaneshwar.
Author

N88-24034# Gregory Geoscience Ltd., Ottawa (Ontario).
REMOTE SENSING AND DATA INTEGRATION: PRACTICAL SOLUTIONS FOR RESOURCE MANAGERS Abstract Only
Jacques Guerette and Bill Bruce (Canada Centre for Remote Sensing, Ottawa, Ontario) *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 (SEE N88-24013 17-43) 1986 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Augmenting data bases, even in data scarce areas, is only one requirement for improved resource management decision making. Equally important is the ability to compile and integrate the particular data sets most appropriate for the resolution of an individual resource problem. This integration must furthermore be accomplished in a fashion which yields effective results within a specific set of time, cost and performance constraints. For many applications computer-based geographical information systems can provide a desirable solution. For many operational resource management agencies, the cost prevents development and support. Attention is being focused on finding practical solutions to the common data integration and update problems faced by such agencies. In Canada, practical needs have contributed to the development of data integration methodologies which are a blend of digital and analog technologies. A system now in use in Canada is described. Applications of this system are presented under the constraints of operational mapping programs in agriculture, forestry, geology, and in map revision. Author

N88-24035# United Nations, New York, N. Y. Outer Space Affairs Div.
THE USSR SPACE SYSTEMS FOR REMOTE SENSING OF EARTH RESOURCES AND THE ENVIRONMENT (SENSOR SYSTEMS, PROCESSING TECHNIQUES, APPLICATIONS) Abstract Only
Rolf-Peter Oesberg *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 317 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The two main techniques in present use of sensing multispectral information for different applications are photography or scanning with detector arrays from air- or space-borne platforms. The USSR remote sensing program has included manned missions on Soyuz spacecraft and Salyut orbital stations, and regular missions of Meteor and Meteor-Priroda (Meteor-Nature) operational satellites carrying multispectral sensor systems. Photography from space was acquired in the early and mid-1970s from the short-duration manned missions on Soyuz spacecraft using single-band and multiband cameras. The MKF-6 multiband camera was first flown on Soyuz-22 in 1976 and was subsequently developed further and flown on many missions, including Salyut-6 and 7. The design and technical parameters of this camera and other sensor systems that were flown on board the USSR spacecraft include the KATE-140 photographic camera on the Salyut-6 and 7 and the scanner systems MSU-M, MSU-S, MSU-SK, Fragment-2 and MSU-E on board the spacecraft Meteor and Meteor-Piroda, basic methodologies of image interpretation and processing techniques and examples of different applications. The technical parameters of these sensor systems are compared with those form other photographic and scanner systems launched or planned. Author

N88-24036# Sociedad Colombiana de Fotogrametria y Percepcion Remota, Bogota.
THE USE OF SLAR AND SIRA IMAGENES FOR THE CLASSIFICATION OF FOREST TYPEN IN TROPICAL RAIN FORESTS Abstract Only
Luis Carlos MolinaMarino *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 323 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The use of the three radar systems, two airborne (Westinghouse and Goodyear) and one spaceborne (SIR-A) for delineation and classification of biomass, ecosystem, and forest types in different ecological conditions of tropical rain forest in Columbia are described. The results are shown in a comparative form with respect to its use. The reflection of vegetation is analyzed in a comparative form with its advantages and limitations. Furthermore, this work presents the classification systems for tropical rain forests utilizing remote sensing imagery. Author

N88-24037# Canada Centre for Remote Sensing, Ottawa (Ontario).
PRACTICAL IMAGE ANALYSIS USING PERSONAL COMPUTERS: THE CANADIAN EXPERIENCE Abstract Only **c60**
Bill Bruce and John K. Hornsby (INTERA Technologies Ltd., Ottawa, Ontario) *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 333-334 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The cost and availability of advanced image analysis technology has limited access to the benefits of remote sensing. Much effort is being devoted to the development of remote sensing-based methods and applications in which the emphasis is on appropriate technology. In the last year, the practical availability of image analysis has increased dramatically. Full digital image analysis capabilities, compatible with all current resource and meteorological satellite digital images are now available on PC-based image analysis systems. All of the image analysis techniques currently recommended by operational remote sensing users in Canada are available. The PC systems now combine adequate throughput and performance with the advantages of low investment and maintenance costs. The systems are upwardly compatible and support highly flexible software, designed for hands-on use by resource professionals. Examples of the advanced remote sensing applications which can be supported solely through the use of such a system are provided. Comparisons with conventional image analysis systems are made in terms of productivity and working environment. The system used to perform the demonstrations is a commercially available turnkey system requiring a minimum of support and operator training; at a cost which is nearly an order of magnitude lower than many conventional image analysis systems. The results presented justify optimistic conclusions concerning the impact on acceptance of remote sensing as a viable resource management tool. Author

N88-24038# European Space Agency, Paris (France).
INTERNATIONAL COOPERATION IN REMOTE SENSING: THE ESA EXPERIENCE Abstract Only **c84**
Valerie Anne Hood *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 337 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The active involvement of the European Space Agency (ESA) with remote sensing began with the establishment of the Earthnet program in 1978. Earthnet acquires data from the American remote sensing satelites (LANDSAT, SEASAT, HCCM, and Nimbus) from its stations in Fulcino, Kiruna, Oakhanger, and Maspalomas. Earthnet acquires remote sensing data and preprocesses them. Each member state of ESA has established a focal point who is responsible for remote sensing data distribution in their country.

Regular meetings are held among the national points of contact and the other users of the data in the Earthnet coverage zone. The European Space Agency also participates in the LANDSAT Station Operators' Working Group. At a bilateral level ESA has many projects with the European Community including airborne campaigns, pilot projects, and training programs. Close contact in remote sensing is also kept with Brazil, Canada, France, United States, Japan, India, and Australia on a bilateral basis. On the meteorological side, ESA has launched Meteosats 1 and 2 and will be launching Meteosat 3 this year. An extensive promotion campaign was carried out in Europe and Africa to encourage countries to use the satellite. Training programs in meteorology and agrometeorology are conducted both by ESA alone and in cooperation with other organizations. The European Space Agency is also preparing ERS-1 and is in the process of negotiating terms for direct access with several states. Author

N88-24039# European Space Agency, Paris (France).
PRESENTATION OF THE METEOSAT SYSTEM AND THE ROLES OF EUMETSAT WITHIN THE METEOROLOGICAL COMMUNITY Abstract Only
Gordon Bridge *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 339-340 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The overall system is presented and the following elements described in some detail: the space segment, i.e., the use of one or more spin-stabilized satellites in geostationary orbit and of reserve satellite located nearby in a hibernated condition in order to provide a continuous service until at least 1995; and the ground segment, the main components being the Data Acquisition, Telemetry, and Tracking Station (DATTS), the METEOSAT Ground Computer System (MGCS), the METEOSAT Operations Control Centre (MOCC), and the Meteorological Information Extraction Centre (MIEC). The objective of the METEOSAT Operational System will be identified as three basic missions: earth imaging, image dissemination; and data collection and distribution including a detailed description of the MDD mission concept (in the view of Brazil). Two important functions of the MIEC will be addressed: meteorological processing and derived products and data archiving and retrieval. In view of the likely establishment of EUMETSAT this summer, a presentation will be made outlining the history of the METEOSAT program and the sequence of events leading to the creation of EUMETSAT. The objective of EUMETSAT will be explained and its role within the meteorological community will be stressed together with the possibilites for cooperative agreements. Author

N88-24040# European Space Agency, Paris (France).
ERS-1 DATA PRODUCTS AND SERVICES AND THEIR VALUE FOR TROPICAL COUNTRIES Abstract Only **c82**
Livio Marelli *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 341 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The European Space Agency will launch in late 1989 its first ocean remote sensing satellite called ERS-1. The mission is experimental and preoperational and is aimed at validating active microwave remote sensing techniques for ocean and ice monitoring, as well as all weather high resolution imaging of the earth surface. Plans are to offer the worldwide user community a global surface about sea state, by providing in near real time ocean parameters. It will also provide regional SAR service both in real time and in an off-line mode. Furthermore, the whole data set collected by ERS-1 will be archived in Europe and will be accessible for historical analysis. The ERS-1 data will provide an opportunity for all weather imaging with a synethetic aperture radar which, in most instances, is the only space sensor able to provide high resolution data in tropical regions where cloud cover makes the usage of visible or infrared sensors very problematic. The Agency plans to define the utilization of the ERS-1 payload in the coming year through the analysis of the announcement of opportunity, the discussion with representatives of contributing countries and with the international partners with whom cooperative agreements would be established. It would appear that Brazil with its long experience in remote sensing, both spaceborne (LANDSAT) and airborne (radar project), would be a valuable potential partner in the exploitation of ERS-1 data. Author

N88-24041# Universidad Nacional de Lujan (Argentina).
ESTIMATION OF AN AREA CULTIVATED WITH WHEAT FROM LANDSAT DATA THROUGH A TWO-PHASE SAMPLING METHOD Abstract Only [ESTIMACION DEL AREA CULTIVADA CON TRIGO A PARTIR DE DATOS LANDSAT MEDIANTE EL METODO DE MUESTREO EN DOS FASES]
Carlos A. Cappelletti and Maria C. Serafini *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 357-360 In SPANISH; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The objective is to estimate the cultivated area of wheat using combined ground and LANDSAT data through a two-phase sampling system with estimation of regression, fixed error rate, and minimum cost. The result obtained was 92.217 ha with a coefficient of variation of 8.93 percent. The results compared with the simulated system by a Monte Carlo technique presented an error (relative difference) of 1.73 percent. Author

N88-24042# Sao Paulo Univ. (Brazil). Escola Superior de Agricultura.
UTILIZATION OF TM/LANDSAT IMAGES IN THE IMPLANTED FORESTS MAPPING IN THE MOGI-GUACU REGION (SP-BRAZIL) [UTILIZACAO DE IMAGENS TM/LANDSAT NO MAPEAMENTO DE FLORESTAS IMPLANTADAS NA REGIAO DE MOGI-GUACU (SP-BRAZIL)]
Carlos A. Vettorazzi and Hilton T. Z. doCouto *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 361-365 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Through the visual interpretation of TM/LANDSAT images and field checking, the forest cover mapping was made of the Horto Mogi-Guacu (Mogi-Guacu-SP). The analysis of the obtained results led to the conculsion that the utilization of images from the spectral bands 3, 4, and 5 were efficient for the forest cover mapping, allowing the discrimination of seven different classes of occupation of the stands: stands being reformed; various native species; angico (Piptadenia spp); tropical pine; eucalypts up to one year old; eucalypts between one and two years old; and eucalypts over two years old. Author

N88-24043# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ANOMALIES IN THE VEGETATION IN THE ALTO XINGU - MT [ANOMALIAS DE VEGETACAO NO ALTO XINGU - MT]
Maria DeLourdesBuenoTrindade, Roberto PereiradaCunha, and Pedro Hernandez Filho *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 366-372 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The MSS and TM LANDSAT data showed anomalies in the vegetal cover in the transition between Amazonian rain forests and cerrado, Brazilian tropical savannah. The study was carried out in the Alto Xingu region (Mato Grosso state, Brazil). Through visual interpretation a map was made showing the spatial distribution of the anomalies in the study area. In order to do the multitemporal monitoring of the anomalies, a test area was selected and MSS images of two different dates were visually interpreted. Within the tests area, for these two dates, a thematic classification

through digital analysis was also carried out on the I-100 Image Analyzer. The auxiliary data used were color infrared photographs (scale 1:15,000) and field information. Author

N88-24044*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RADAR PENETRATION IN THE AMAZONIAN RAIN FOREST
Roberto PereiradaCunha (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil) and John P. Ford *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 373-374 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Radar return from vegetation covered terrains is due to three components: the scattering resulting from the top surface of the vegetation canopy (surface scattering); the scattering which occurs within the vegetation layer (volume scattering); and the scattering which takes place at the surface below the vegetation canopy (ground scattering). Through the studies of selected areas a case is presented where most of the radar return observed in radar imageries results from the scattering at the surface below the vegetation layer (ground scattering). Author

N88-24045# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REMOTE SENSING TECHNIQUES IN THE ESTIMATION OF THE AREA CULTIVATED WITH BEANS, CORN, AND CASTOR BEANS IN THE IRECE COUNTY (BAHIA STATE) [SENSORIAMENTO REMOTO NA ESTIMATIVA DA AREA PLANTADA COM FEIJAO, MILHO E MAMONA NO MUNICIPIO DE IRECE]
Bernardo F. T. Rudorff and Thelma Krug *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 380-384 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The objective was to obtain an estimation of the areas cultivated with beans, corn, and castor beans in the Irece county (Bahia State) using statistical and remote sensing techniques. Using a topographic chart at a scale of 1:100,000 the county area was divided into approximately 2000 segments of 2 x 1 km. A random sample of 97 segments (corresponding to 5 percent of the target area) was considered. Over these segments aerial vertical photographs were obtained in the approximate scale of 1:40,000 by means of a 35 mm camera with a wide-angle of 28 mm focal length lens aboard a Cherokee-six aircraft. The projection of the aerial color photographs over 1:5000 cadastrial maps available in the region made it possible to extract the thematic information of the planted areas of interest. Subsequently an evaluation of the area cultivated with beans, corn, and castor beans was made. From the results the estimates (punctual and by interval) were obtained and the following results encountered: 87,759 ha with beans, 76,519 ha with castor beans, and 10,550 ha with corn. Author

N88-24046# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CANASATE: SUGAR CANE MAPPING BY SATELLITE [CANASATE - MAPEAMENTO DA CANA-DE-ACUCAR POR SATELITE]
Francisco Jose Mendonca *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 385-393 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The CANASATE Project, sugarcane mapping by satellite, has the objective of obtaining the spatial distribution and area estimation of sugarcane plantations, at national level, using remote sensing techniques. To achieve this objective, Brazil was divided into three areas: Area 1, which includes Rio de Janeiro, Sao Paulo, and Parana states; Area 2, which includes Alagoas, Pernambuco, Paraiba, and Rio Grande do Norte states; and Area 3, which includes Minas Gerais, Espirito Santo, Goias, and Mato Grosso do Sul states. The results show that Area 1 represents approximately 60 percent of the national sugarcane plantations. Twenty-three thematic maps on the scale of 1:250,000 were obtained using LANDSAT MSS or TM images of 1983 and 1984. The results were: 236,635 ha in Rio de Janeiro state; 2,158,000 ha in Sao Paulo state; and 135,859 ha in Parana state. The overal average accuracy on the estimation was 91 percent. Author

N88-24047# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SPECTRAL BEHAVIOR OF CROPS THROUGH ANALYSIS OF LANDSAT-TM DATA [COMPORTAMENTO ESPECTRAL DE CULTURAS A PARTIR DA ANALISE DE DADOS DO LANDSAT TM]
Sherry Chou Chen, Jean Francois Dallemand, and Daniel Alfredo Rosenthal *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 394-401 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The LANDSAT-TM digital data of January 19, 1985, were requested for a 15 x 15 km area near Maringa, Parana State to study spectral response of agricultural crops of soybeans, corn, and sugarcane. Study results show that correlations were found between spectral data of visible bands (band 1, 2, and 3) and infrared bands (band 4 vs 5 and band 5 vs 7). Among the six TM bands analyzed, bands 4 and 5 contained more information than the others. For crop discrimination using single TM bands, band 4 was the best even though differentiations of soybeans from non-soybeans was possible in bands 5 and 7. These preliminary results indicate not only the potential of LANDSAT-TM data for crop discrimination, but also differentiations of sugarcane varieties and the soybean biomass. Author

N88-24048# Empresa Brasileiro de Pesquisa Agropecuaria, Planaltina.
IDENTIFICATION OF AREAS CULTIVATED WITH SOYBEANS IN THE CERRADOS REGIONS, THROUGH DIGITAL PROCESSING OF SATELLITE IMAGES: A METHODOLOGICAL APPROACH [IDENTIFICACAO DE AREAS CULTIVADAS COM SOJA NOS CERRADOS, ATRAVES DO PROCESSAMENTO DIGITAL DE IMAGENS DE SATELITE: UM APORTE METODOLOGICO]
Paulo Jorge RosaCarneiro *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 402-417 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Soybean growing recently introduced in the cerrado region, has shown exceptional growth in areal extent every year. Digital processing of LANDSAT images makes it possible to accompany this evolution with efficiency, providing precise data such as area planted and expected yield, of great use in planning actions necessary for strengthening this sector. Author

N88-24049# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STRUCTURE AND DYNAMICS OF VEGETATION IN THE MIDDLE SEMI-ARID TROPICS. QUIXABA'S CAATINGA (PE): TERRAIN ANALYSIS OF MSS/LANDSAT DATA [ESTRUTURA E DINAMICA DA VEGETACAO EM MEIO TROPICAL SEMI-ARIDO. A CAATINGA DE QUIXABA (PE): DO TERRENO A ANALISE DE DADOS MSS/LANDSAT]
Vitor CelsodeCarvalho *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 418-426 In PORTUGUESE; ENGLISH summary (For primary document see

N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Estimation of practibility and limits of MSS/LANDSAT data for monitoring and the control of the tropical semi-arid ecosystems from a test region of Brazilian Nordeste, north of Petroline-PE (Quixaba) and their vegetal cover are presented. A structural classification of the vegetation is developed and applied. Then, a 1:100,000 scale structural mapping, drawn from the 1955, 1965, and 1983 aerial photographs, allows structural characterization and dynamic evaluation of the Quixabas Caatinga. The power discrimination of the images from four MSS/LANDSAT scenes (1973, 1974, and 1983-2) numerical processing, are estimated, by comparison to vegetation structure maps: while in these maps, 15 thematic classes are distinguished, only 7 are available on the classified picture (maximum). Author

N88-24050# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REMOTE SENSING AND STRUCTURAL RUPTURE: APPLICATION EXAMPLES IN THE STUDY OF TECTONICS [O SENSORIAMENTO REMOTO E A ESTRUTURA RUPTIL: EXEMPLOS DE APLICACOES EM ESTUDOS TECTONICOS]
Athos RibeirodosSantos *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 429-434 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The regional distribution of the linear structural features is best characterized in small scale remote sensing products. The development of structural studies utilizing remote sensing data has provided a systematic procedure of photointerpretation with the purpose of the extraction of structural information in a regional scale. Some of these procedural methodology, potentiality, limitations, and results are shown and discussed. The remote sensing techniques contribute good results in the regional tectonic studies. With these techniques, both brittle and brittle-ductile tectonics can be deduced. Author

N88-24051# Rio Grande do Sul Univ., Porto Alegre (Brazil).
ANALYSIS AND INTERPRETATION OF IMAGE LITHOSTRUCTURE: AN APPLICATION OF THE MULTICONCEPT IN THE METAMORPHIC BELT OF SUL DE SANTANA DA BOA VISTA (RS) [ANALISE E INTERPRETACAO LITOESTRUTURAL DE IMAGENS. UMA APLICACAO DO CONCEITO MULTI NA FAIXA METAMORFICA AO SUL DE SANTANA DA BOA VISTA - RS]
Marisa T. G. DeOliveiraSchuck, Nelson AmorettiLisboa, and Nilo ClementeEick *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 435-446 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A belt of metamorphic rocks was analyzed through the visual interpretation of radar and photographic images, applying the multiconcept. On the radar images part of a big folded structure, of the antiform type, which is fractured by faulting, was regionally defined. On the aerial photography a detail was worked through the litho and structural photoanalysis and photointerpretation; and seven photogeologic units could be defined. By means of photogeologic criteria the king of faulting as well as the relative block movement was qualitatively defined in some cases. A lot of geologic information could be obtained comparing these different images. A possible sequence of geologic events, which have caused the actual rock spatial position, could be established. Author

N88-24052# Instituto de Economia e Pesquisas, Aracaju (Brazil).
STUDY OF FRACTURING FOR GROUNDWATER RESEARCH IN THE SERGIPE STATE WITH REMOTE SENSING PRODUCTS [ESTUDOS DE FRATURAMENTOS PARA PESQUISA DE AGUA SUBTERRANEA NO ESTADO DE SERGIPE COM PRODUTOS DE SENSORIAMENTO REMOTO]
Osvaldo SouzaSampaio, Juercio TavaresdeMattos, and Paulo Veneziani (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil) *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 447-452 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

For groundwater prospecting in Sergipe Crystalline Complex, a systematic interpretation of the remote sensing data was conducted and enabled the delineation of some potential areas for groundwater exploration in the future. The method used includes the analysis of terrain relief and drainage for delineating the principal joint and fault systems and characterizing the favorable morphostructures. Owing to the fact that the Precambrain complex is extremely compact and impermeable, the only groundwater reservoirs occur in the fractured zones in the crystalline rocks, so that morphostructure mapping is the way for groundwater prospecting. Author

N88-24053# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PROCESSING OF HRPT DATA FROM THE NOAA SERIES SATELLITES [PROCESSAMENTO DOS DADOS HRPT DOS SATELITES DA SERIE NOAA] **c47**
Carlos Ho Shih Ning, Keiko Tanaka, Maria Roseli Cabral, Yoshihiro Yamazaki, and Yukitaka Nakamura *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 455-463 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

TIROS-N is the first of a series of operational polar-orbiting meteorological satellites and was followed by NOAA-6 to 9. Aboard each spacecraft are three passive sounding instruments: the High Resolution Infrared Radiation Sounder (HIRS-2), a radiometer with 19 channels in the infrared and 1 in the visible; the Microwave Sound Unit (MSU), with 4 channels; and the Stratospheric Sounder Unit (SSU) with 3 channels. In addition to these instruments, which constitute the TIROS-N Operational Vertical Sounder (TOVS), these satellites transmit images from the Advanced Very High Resolution Radiometer (AVHRR) sensitive in the visible, near infrared, and middle infrared window regions. These data with telemetry and other instrumental data constitute the High Resolution Picture Transmission (HRPT) data set. The HRPT data are transmitted in the S-band and received by parabolic antenna with 4 m diameter at the INPE/Cachoeira Paulists Meteorological Satellite Reception Station. The signals are processed in the minicomputer and digitized in CCT tapes at 1600 BPI density. The general description of TOVS and AVHRR data are presented together with the system developed for the files creation for calibration and applications to the meteorological satellites. Author

N88-24054# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NAVIGATION SYSTEM FROM AVHRR DATA FROM NOAA SERIES SATELLITES [SISTEMA DE NAVEGACAO DOS DADOS AVHRR DOS SATELITES DA SERIE NOAA] **c47**
Valder deMatosMedeiros, Keiko Tanaka, and Yoshihiro Yamazaki *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 464-471 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

An analytical mathematical formulation is described for determining the geographical coordinates of pixels obtained through

the Advanced Very High Resolution Radiometer (AVHRR) aboard the polar orbit NOAA series satellite. The basic formulation is presented in the following two parts: a transformation of the image coordinates (line and element numbers) to geographical coordinates (latitude and longitude); and the inverse problem. The equatorial crossing data were taken as given in the TBUS message form, and a specific system of orbit propagation were developed for the problem in question. Some results are presented for the digital images recorded by the Meteorological Satellite Reception Station of INPE/Cachoeira Paulista, Sao Paulo State. Author

N88-24055# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
COMPARISON OF THE SOLAR RADIATION ESTIMATION METHOD BY SATELLITES [AFERICAO DO METODO DE ESTIMATIVA DA RADIACAO SOLAR POR SATELITES] **c47**
Elisabete CariaMoraes and Fausto CarlosdeAlmeida *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 472-478 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The recent improved results shown by meteorological satellite data extraction techniques, together with the existing very sparse basic meteorological network in Brazil, has motivated a greater interest in the development of these techniques. In particular, the problem of solar radiation incident on the earth's surface was studied using the GOES satellite visible channel imagery. In this study, based on a field experiment (Sao Jose dos Campos, April 1985), comparisons among instantaneous and integrated (daily) estimation, obtained by satellite, piranometer, sunshine observations and conventional models (based on surface meteorological data) were done. The results showed that the satellite estimations, taking into consideration its temporal and spatial resolutions, error (14 percent for clear skies or cirrus cover and 35 percent for cloudy skies), and geographical coverage; it is the most practical of all. The study also indicates that a better understanding of aerosol scattering and cloud radiation interactions will improve the accuracy of the satellite estimates. Author

N88-24056# Instituto de Cartografia Aeronautica, Rio de Janeiro (Brazil).
A SYSTEM FOR DETERMINATION OF WIND FIELDS USING GEOSTATIONARY METEROLOGICAL SATELLITES [UM SISTEMA PARA A DETERMINACAO DE CAMPOS DE VENTOS UTILIZANDO SATELITES METEOROLOGICOS GEOSTACIONARIOS] **c47**
Eni AlvimdeOliveira, Nelson D. A. Mascarenhas, and Alberto W. Setzer *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 479-484 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Wind fields are sets of vectors that indicate the velocity and the direction of the wind in a given region. These fields enable the study of the atmosphere dynamics, as it described the fluid flow in it. Since the clouds move by the action of the wind at the level where they are, their tracking allows the derivation of movements in the atmosphere. The wind fields can be obtained through cloud tracking in a sequence of geostationary meteorological satellite imagery, generated in known time intervals. Therefore, altitude data can be complemented in the intervals between radiosonde launchings, and it is also possible to acquire data in areas not covered by radiosonding, such as oceans, and mountains. The placement of geostationary satellites approximately over the same location on the earth allows the observation of cloud displacement in a sequence of images and the determination of wind fields. A system under development at INPE to determine wind field through low cloud tracking in image sequences is described. Such a system comprises the following modules: image navigation; selection of clouds suitable for tracking cloud movement determination through image registration; cloud altitude assignment and validation of results. After completion, this system will be used by the Meteorology Department of INPE, in data acquisition for numerical weather prediction and in the analysis of individual synoptic situations. Author

N88-24057# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DIGITAL PROCESSING OF INFRARED AND VISIBLE IMAGES FROM THE GOES SATELLITE AND ITS INTEGRATION WITH METEOROLOGICAL RADAR DATA [PROCESSAMENTO DIGITAL DE IMAGENS INFRAVERMELHO E VISIVEL DO SATELITE GOES E SUA INTEGRACAO COM DADOS DE RADAR METEOROLOGICO] **c47**
Jorge Conrado Conforte, Maria AparecidaSenaubarAlves, Fausto CarlosdeAlmeida, and Oswaldo Massambani (Sao Paulo Univ., Brazil) *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 485-493 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A methodology for the composition of digital images from the GOES meteorological satellite with those of the meteorological radar at Bauru, SP, is presented allowing for the development of algorithms which permit the determination of precipitation fields in regions covered by these instruments. This methodology is necessary to match the plane spatial resolution of visible and infrared images of the satellite with the volumetric resolution of the band C radar. The Constant Altitude Plan Position Indicator (CAPPI) of radar images were remapped to the coordinate system of the satellite (line, element), which was itself navigated to terrestrial coordinates (latitude, longitude). The errors observed were compatible with the methodology, and the results should allow future estimates of precipitation fields, resulting in one more benefit from the use of remote sensing in the monitoring of the atmosphere. Author

N88-24058# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NEAR SURFACE CURRENT DETERMINED FROM INPE'S SATELLITE-TRACKED BUOY, DURING 6-26 NOVEMBER, 1985 **c48**
Merritt R. Stevenson and Eduardo M. B. Alonso *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 494-500 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A field experiment was made to test INPE's drifting, oceanographic buoy during the 6th through the 26th of November, 1985. Buoy measurements obtained during the 10th through the 20th of November were made from the Brazilian hydrographic ship Alte, Saldanha, near 24 deg 8 min S, 45 deg 13 min W. Within the buoy, a UHF transmitter compatible with the System ARGOS, transmitted sensor data via an omnidirectional antenna. The System ARGOS aboard polar orbiting satellites received, recorded, and retransmitted the buoy signals. Geographic fixes were determined from the Doppler frequency of the buoy transmissions, in combination with the known orbital characteristics of the satellite receiving the signals. Positional accuracy of the buoy was estimated by determining positional differences with respect to the five mean positions, and then combining these differences to make an overall estimate of the positional error. The experiment suggests that the INPE drifting buoy is capable of obtaining useful measurements of near surface currents. Author

N88-24059# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TIROS OPERATIONAL VERTICAL SOUNDER (TOVS) AND RADIOSONDING IN THE REGION [O TOVS E AS RADIOSONDAGENS NO PAIS] **c47**
Paulo Roberto Foster, Yoshihiro Yamazaki, Carlos Ho Shih Ning,

and Maria Roseli Cabral *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 501-507 In PORTUGUESE; ENGLISH summary Original language document was announced as N88-20743 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The Environmental Satellite Service of the U.S. (ESSA) has the capacity today to produce around 20,000 vertical soundings of the atmosphere over the globe for every 24 hours using information from the satellite sensors (TOVS) of two polar orbit operational satellite series of NOAA. The processed satellite data from ESSA and the simultaneously selected local time conventional meteorological radiosondes of some meteorological stations of Brazil are analyzed for two seasons of the year (summer and winter). The comparison between the two vertical thermal structures obtained by these distinct methods are presented. Within a certain limit, the short range forecast by meteorologists is perfectly acceptable for practical purposes. This demonstrates that the orbital polar satellites have great potential. Author

N88-24060# Diretoria de Servico Geografico do Exercito, Sao Paulo dos Campos (Brazil).
THEMATIC MAPPING UTILIZING DATA FROM THE THEMATIC MAPPER SENSOR OF THE LANDSAT SATELLITE [MAPAS TEMATICOS UTILIZANDO DADOS DO SENSOR THEMATIC MAPPER DO SATELITE LANDSAT]
Luis AntoniodeAndrade *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 511-525 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A methodology for the elaboration of thematic maps in the scale 1:100,000 is developed. Techniques of digital processing and visual analysis of remote sensing images were used. The Thematic Mapper of the LANDSAT satellite was employed and the selected area of study was Formosa (GO). The analysis of the spectral, spatial, and temporal attributes of digital and photographic paper images of the Thematic Mapper (LANDSAT) helped by ancillary data (pedology, topography, geology, potential agriculture use) and ground observations of surface characteristics constitute the framework. The principal contribution is to make possible the use of thematic maps through satellite images as well as allow a constant updating of existent maps. Author

N88-24061# Instituto de Cartografia Aeronautica, Rio de Janeiro (Brazil).
GEOMETRIC IMAGE CORRECTION: AN APPROACH FOR THE REGISTRATION OF LANDSAT-TM DIGITAL IMAGES SUPPORTED BY TOPOGRAPHICAL MAPS OF MEDIUM AND GREAT SCALES [CORRECAO GEOMETRICA DE IMAGENS: UMA ABORDAGEM PARA O REGISTRO DE IMAGENS DIGITAIS LANDSAT-TM APOIADO EM CARTAS TOPOGRAFICAS DE GRANDE E MEDIA ESCALA]
Carlos Alberto GoncalvesdeArujo and Julio Cesar LimadAlge *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 526-530 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Satellite images present geometric distortions that are a function of the sensor systems and of the variations in the platform attitude, speed, and height. The aim is to develop a procedure for the correction of LANDSAT-TM digital images based on data obtained from topographic maps of medium and great scales. A simularity transformation was used followed by a polynomial mapping to match a TM image to a topographic map considered as a standard. The results show a root mean square error of about 900 m in the TM digital image processed at INPE. After the application of the procedure described, that error is reduced to about 250 m.
Author

N88-24062# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
GENERATION OF THEMATIC MAPS FOR UPDATING AERONAUTICAL PILOT CHARTS UTILIZING LANDSAT-TM IMAGES [GERACAO DE DADOS TEMATICOS PARA ATUALIZACAO DE CARTAS AERONAUTICAS DE PILOTAGEM UTILIZANDO IMAGENS LANDSAT-TM]
Carlos Alberto G. DeAraujo, Ernest Ulrich Fischer, Nelson D. A. Mascarenhas, and Guaraci Jose Erthal *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 531-537 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A system for the updating of aeronautical pilot charts is described, by using thematic maps obtained through the classification of LANDSAT-TM images. Such systems comprise the following modules: registration of the orbital images with the pilot chart by means of control points; statistical classification of these images by using supervised methods (maximum likelihood algorithm); classification homogenizing as a post-processing stage, for deleting nonsignificant areas; edge detection between neighbor themes; data conversion from raster structure to vector structure; and plotting of the borders between classes. Presently under study is the use of data obtained by spatial filtering in the supervised classification, aiming at a greater area homogeneity at the classification stage. Author

N88-24063# Toulouse Univ. (France).
THE SAGE GEOGRAPHIC ANALYSIS SYSTEM
R. Caubet and A. Hameurlain *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 541-547 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The design and implementation of a geographic analysis system, SAGE, is described. A classification of geographic analysis database queries and two geographic data manipulation modes are presented. Then, after establishing a database model for geographic charts, integrity contraints are specified for the time and space elements of the geographic database and a means of ensuring the structural coherence of geographic objects is discussed. Author

N88-24064# Universidade Estadual de Paulista, Guaratingueta (Brazil). Dept. de Planejamento Regional.
IMPLANTATION OF A GEO-CARTOGRAPHICAL INFORMATION SYSTEM THROUGH MICROCOMPUTERS [IMPLANTACAO DE UM SISTEMA DE INFORMACAO GEO-CARTOGRAFICA ATRAVES DE MICROCOMPUTADOR]
A. L. A. Teixeira and L. H. O. Gerardi *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 548-553 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The introduction of quantitative methods as a tool for data analysis, has caused impact changes in the scientific approach to geographic problems. The growing automation of the cartographic process has changed cartography in a very significant way. Common to both cases is the problem of the enormous amount of data to be manipulated and analyzed. This volume can not be efficiently treated if more modern techniques are not used. All this considered, a geo-cartographical information system was idealized, planned, and implemented using database techniques and the microcomputer as a basic tool. Author

N88-24065# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVOLUTION OF A FAMILY OF IMAGE PROCESSING SYSTEMS AT INPE [EVOLUCAO DA FAMILIA DE SISTEMAS DE TRATAMENTO DE IMAGENS DO INPE] c82
Ricardo Cartaxo ModestodeSouza, Celso Luis Mendes, Juan Carlos

PintodeGarrido, and Gilberto Camara Neto *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 554-557 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The proposed evolution, in the next few years, for the family of image processing systems under development at MCT/INPE is described. The family comprises several configurations with various price/performance relations. The basic characteristics of the members of the family are presented; technological trends which will influence future members of the family are discussed, such as VLSI architecture, graphical techniques, and parallel processing. Author

N88-24066# Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
SPECTRAL MEASUREMENTS FOR CORRECTING LANDSAT DATA FOR ATMOSPHERIC EFFECTS **c82**
A. Brizuela, M. A. Raed, G. Herren, and C. Martinez Casado *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 558-561 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Combined ground truth measurement, with an Exotech Model 100-A radiometer, and digital values from LANDSAT-4 MSS, from the same area, and at the same time, were evaluated to correct the atmospheric effect. The parameters were the beam transmittance and path radiance, in the four optical bands, determined from corresponding measurements of sun radiance as a function of sun elevation sky radiance, and azimuth angle. This experimental method was compared with empirical methods and there was a high correlation, between the radiances sensed by the LANDSAT-4 MSS and the ground truth measurements, corrected by means of the atmospheric effects. Author

N88-24067# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STUDY OF METHODS OF POST-PROCESSING APPLIED TO A PROBLEM OF STANDARD CLASSIFICATION [ESTUDO DE METODOS DE POS-PROCESSAMENTO APLICADO A PROBLEMA DE CLASSIFICACAO DE PADROES] **c82**
Luciano Vieira Dutra and Jose Carlos Moreira *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 562-568 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

In order to identify the various objects within a multispectral image, per point classification methods are normally used. This kind of method does not use the spatial information among the pixels of the images, thereby producing a higher classification error. The spatial information can be added before, within and after the classification stage. Two methods of post-processing which take account of the spatial relationship between pixels are presented. The first one is based on a local histogram of the pixel's class. The central pixel is reclassified to the most occurring class, provided the frequency is higher than a selected threshold. The results show a fairly better classification performance and a good improvement of the visual appearance. The second method is based on a generalization of the expansion-striking concept of binary images applied to the individual classes. This method did not lead to a better performance in terms of classification precision but allowed the identification of pixels of mixed classes, which occur mainly in the border between classes, allowing a better localization of these frontiers. Author

N88-24068# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A PROPOSAL OF ADAPTATION OF A KNOWLEDGE-BASED SCENE ANALYSIS MODEL TO SOME REMOTE SENSING PROBLEMS **c82**
Paulo Ouvera Simoni *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 569-575 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A scene analysis computer program, developed according to an AI paradigm, is described through its representational and control components. The available declarative knowledge about a domain or process can be stored in a particular type of associative network, in the form of concepts, part and particularization hierarchies, predicate calculus-like formulae, or decision rules. Procedural knowledge can also be provided by many forms, as codes associated to attributes and predicates, actions to be performed after concept activation and control affecting heuristics. Control can be viewed as a series of propagation of alterations, problem solving, and image measurement steps. The necessary adaptations to be performed over this program in order to store knowledge from experts on remote sensing and image analysis problems are discussed. Some of these problems are related to the analysis of geological sites, map guided interpretation and knowledge-based segmentation. Author

N88-24069# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
UTILIZATION OF LANDSAT-TM , FOR AIDING IN THE LOCALIZATION OF ARCHEOLOGICAL SITES IN THE STATE OF SAO PAULO [UTILIZACAO DE IMAGENS LANDSAT/TM, PARA AUXILIAR NA LOCALIZACAO DE SITIOS ARQUEOLOGICOS NO ESTADO DE SAO PAULO]
Vitalina Pagliuca Cicivizzo (Sao Paulo Univ., Brazil) and Tania Maria Sausen *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 579-582 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A methodology for TM/LANDSAT images, for the identification of geomorphological forms and spectral patterns that may serve as indicators for the localization of archaeological sites was developed. As a result, maps with the identification of the possible localization of archaeological sites will be developed as well as the characterization of spectral and geomorphological patterns that prompt the identification of such sites. Author

N88-24070# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ANALYSIS OF THE PARAMETERS RESPONSIBLE FOR THE VARIATIONS OF THE ILLUMINATION CONDITIONS IN THE LANSAT DATA [ANALISE DOS PARAMETROS RESPONSAVEIS PELAS VARIACOES DAS CONDICOES DE ILUMINACAO NOS DADOS LANDSAT]
R. Rosa and E. E. Sano *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 583-588 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The variations in the tonality (photographic paper products) or in the digital values (computer compatible tapes (CCT) of LANDSAT data are associated with the spectral signatures of objects, atmospheric conditions, geometric measurement, and illuminations, this last is analyzed in the presented work. The parameters that influence the illumination conditions are the geometric relationships between the sensor system, the sun (solar angle of elevation and azimuth), and the surface (orientation and inclination). These parameters are defined and discussed, as well as, their implications on the LANDSAT data. B.G.

N88-24071# BP Mineracao Ltda., Rio de Janeiro (Brazil).
TORNADO TRACKS IN SOUTHWESTERN BRAZIL, EASTERN PARAGUAY, AND NORTHWESTERN ARGENTINA [RASTROS DE TORNADOS NO SUDOESTE DO BRASIL, LESTE DO PARAGUAI E NORDESTE DA ARGENTINA] **c47**

Robert C. Dyer *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 589-603 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A series of tornado tracks which were identified in a region that encompasses part of eastern Paraguay, southwestern Brazil, and northeastern Argentina is described. The tracks are clearly observable on 1965 black-and-white photographs (1:60,000) and on some of the early 1970 LANDSAR imagery. The multitemporal assessment of different photocoverages and LANDSAT imagery pertaining to the depicted region, showed that most of those tornadoes struck the region sometime between June 1964 and July 1965; a few tracks were determined to belong to tornadoes that hit the region in earlier years and one, in later years. The most extensive trajectories are 70 km long, and the widest, around 2 km. The severe deforestation that took place in the region in the late 1960s obliterated almost completely the tornado scars on more recent remote sensing products. A scan of the literature pertaining to the region under investigation resulted in the gathering of some interesting information on damages caused by the effect of such tornadoes. Author

N88-24072# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
INTERPRETATION OF MSS/LANDSAT DATA FOR EVALUATION OF PHYSICAL DISTRIBUTION OF MANGROVES IN CANANEIA-IGUAPE (SP) [INTERPRETACAO DE DADOS MSS/LANDSAT PARA AVALIAR A DISTRIBUICAO FISICA DOS MANGUEZAIS DE CANANEIA-IGUAPE (SP)]
Carmen Regina SilveiraEspindola *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 604-614 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Mangrove is considered responsible for the high productivity of biological and ecological coastal systems. However, it is unknown and strongly destroyed, requiring appropriate research techniques to provide fast and cheap procedures for its identification. Remote sensing techniques using digitally processed satellite data, were found to be valuable not only for its low cost, but also for its overall view. The objective is to evaluate the physical distribution of Cananeia-Iguape mangroves using MSS-LANDSAT image processing and correlate it with radar images and aerial photographs. A statistical classification performed by algorithms used by the Multispectral Interactive Image Analyzing System (IMAGE-100) provided a thematic map with 13 mangrove units from which areas were calculated and correlated with areas obtained from panchromatic aerial photographs and from radar images. The results indicate very high linear correlation coefficients ($r = 0.99$) which showed that the use of MSS-LANDSAT products are good enough to spectrally separate mangroves from other soil cover types. Author

N88-24073# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF A BURNED AREA AND THE VEGETATION REGENERATION AFFECTED BY THE BURNING IN THE PARQUE NACIONAL DE BRAZILIA THROUGH TM/LANDSAT DATA [AVALIACAO DA AREA QUEIMADA E DA REGENERACAO DA VEGETACAO AFETADA PELO FOGO NO PARQUE NACIONAL DE BRASILIA ATRAVES DE DADOS DO TM/LANDSAT]
Flavio Jorge Ponzoni, David Chung Liang Lee, and Pedro Hernandez Filho *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 615-621 In PORTUGUESE; ENGLISH summary Original language document was announced as N87-14764 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The TM/LANDSAT multitemporal images were used in monitoring and evaluating a burned area and the vegetation regeneration in the Parque Nacional de Brazilia (PNB). These images were analyzed visually and automatically in order to identify the best TM/LANDSAT bands and to evaluate the usefullness of these images in this kind of study. The TM/LANDSAT bands which presented the best separation of the PNB's land cover categories were bands 4 and 5. The first one was identified by visual analysis and the second by the automatic analysis. The beginning of the vegetation regeneration was detected visually in an image color composite of the area of interest corresponding to a passage of approximately 2 months after the fire. Author

N88-24074# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
LOW ALTITUDE REMOTE SENSING DATA IN THE IMPLEMENTATION OF A MATHEMATICAL MODEL FOR THE PLANNING OF URBAN EQUIPMENT NETWORKS [DADOS DE SENSORIAMENTO REMOTO A BAIXA ALTITUDE NA IMPLEMENTACAO DE UM MODELO MATEMATICO PARA O PLANEJAMENTO DE REDES DE EQUIPAMENTOS URBANOS]
c85
Maria deLoudesNevesdeOliveiraKurkdjian, Maria Suelena SantiadoBarros, Horacio HidekiYanasse, Acioli AntoniodeOlivo, and Nandamudi Lankalapal Vijaykumar *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 622-629 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

This work is mainly directed to urban planners involved in solving local social use equipment location problems. Such equipment is generated as an extension of the residential function and, therefore, their location in the urban structure must follow the distribution of the different population segments in the city. Photointerpretation data is used to supply the lack of urban information, a common fact observed in the municipal administration in Brazil. The aerial photographic data are used to locate, quantify, and give priority to the equipment demand, being the last aspect function of the socio-economic conditions of the several groups of households. The data from the photointerpretation are used to model the system as a network in order to rationalize the urban equipment location. This methodology was applied using as a test area Sao Jose dos Campos, SP, where the best location for a network of urban health equipment for local use was indicated. Author

N88-24075# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF AN ESTIMATION SYSTEM FOR AN IRRIGATED AREA IN A TROPICAL REGION THROUGH TM-LANDSAT IMAGERY [AVALIACAO DE UM SISTEMA DE ESTIMATIVA DE AREA IRRIGADA EM REGIAO TROPICAL ATRAVES DE IMAGENS TM-LANDSAT]
Sherry C. Chen, Evlyn M. Leao Novo, Sergio dosAnjos F. Pinto, Mario Valerio Filho, and Roberto Rosa (Universidade Federal de Uberlandia, Brazil) *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 630-637 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A joint project of the Sao Paulo State Department of Water and Energy (DAEE) and INPE was performed to evaluate the possibility of using LANDSAT-TM imagery for irrigated area estimation in the water basin of Piracicaba. Successful studies were reported in the semi-arid region where the identification of irrigated areas using remotely sensed data obtained during the dry season is relatively trivial due to the presence of green biomass. However, in the tropical environment, there is no well defined dry period and the cropping and irrigation systems are diversified, these factors make the task of estimating irrigated areas difficult. Two methods were proposed to estimate irrigated areas: direct expansion of field information collected in sampled segments when

LANDSAT data are not available and regression estimation using ground-gathered data of sampled segments and multidate LANDSAT false color images. Study results show that when the LANDSAT data were used and incorporated to ground information of the randomly selected segments, a reduction of 94.02 percent in variance of the estimated acreage was achieved compared to that obtained using the approach of direct expansion. The advantages and limitations of using LANDSAT data to estimate irrigated areas in tropical climates are also presented. Author

N88-24076# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STUDY OF RESERVOIR WATER QUALITY UTILIZING REMOTE SENSING TECHNIQUES: METHODOLOGICAL CONCEPTS [ESTUDO DE QUALIDADE DAGUA DE RESERVATORIOS, UTILIZANDO TECNICAS DE SENSORIAMENTO REMOTO: CONCEITOS METODOLOGICOS]
Tania Maria Sausen and Marisa DantasBitencourtPereira (Sao Paulo Univ., Brazil) *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 638-644 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The objective is to inform the public and the scientific community about the importance of an efficient methodology for monitoring artificially acumulated water and the uselessness of the remote sensing techniques as a practical and economic alternative to minimize the field trip work wherever water quality parameters are to be investigated. In order to achieve these aims, a bibliographic study of this subject was done through the main papers for the last two decades. Methodological topics are shown taking into account the spectral response of water (with and without sediments) and techniques to analyze remote sensing data. Author

N88-24077# THEMAG Egenharia Ltda., Sao Paulo (Brazil).
UTILIZATION OF LANDSAT-TM IMAGERY IN THE HYDROENERGETIC INVENTORY OF THE PARAIBA DE SUL RIVER BASIN [UTILIZACAO DE IMAGENS LANDSAT TM NO INVENTARIO HIDROENERGETICO DA BASIA DO RIO PARAIBA DO SUL]
Augusto Paiva Filho, Carlos Bianco, and Tania Maria Sausen (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil) *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 645-653 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The THEMAG Engenharia Ltda developed a power study in an inventory level in the Paraiba Basin, Sub-basin 2. The aim of this study was to establish in the Paraiba do Sul River and its affluentes (mainly the Sao Manoel, Sopoto, and Novo Rivers) alternatives for power plant schemes in a suitable profile. The TM digital products of the land use studies performed over the planned reservoirs and the surrounding areas were used. The CCT TM Quadrant Digital Products with the desired spectral band selected for this purpose were useful in identifying and surveying land use categories: urban areas, agricultural ideas, forest areas, grazing areas, and drainage. Author

N88-24078# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF THE FLOODABLE AREA OF THE CANAL OF SAO GONCALO THROUGH TM-LANDSAT 5 IMAGERY [AVALIACAO DA AREA DE INUNDACAO DO CANAL DE SAO GONCALO ATRAVES IMAGENS TM-LANDSAT 5]
C. Hartmann, R. A. C. Lamparelli, R. Rosa, and E. E. Sano *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 654-659 In PORTUGUESE; ENGLISH summary Prepared in cooperation with Fundacao Univ. do Rio Grande (Brazil). (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Two LANDSAT TM images were digitally processed on the I-100 Image Analyzer of INPE Sao Jose dos Campos, Sao Paulo). The floodable area of the canal de Sao Goncalo was studied. One image associated with exceptional high inundation (June 11, 1984) and one image associated with normal water level (December 4, 1984) were compared. The digital classification (1:50,000 scale) led to a map (1:100,000 scale) showing the limits of the flooding. This work demonstrated the usefulness of remote sensing techniques to demilitate and identify floodable areas. Author

N88-24079# Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
COMTAL VISION ONE/20 PROGRAMMING PROCESSOR SYSTEM FROM THE VAX 11/780 [PROGRAMACION DEL PROCESADOR DEL SISTEMA COMTAL VISION ONE/20 DESDE VAX-11/780] **c61**
A. Sedeno *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 665-668 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The COMTAL Vision One/20 interactive image processing system includes a set of software options in its configuration. This system also provides a space in memory available to the user for the inclusion of executable code. In order to extend the present interactive processing capability, a programming system of the Vision One/20 LSI-11 processor was developed that allows the programmer to write his own applications programs in a DEC VAX-11/780 computer connected with the Vision One/20 system and to include easily that code in the RAM memory available in the processor of that system. The programming system makes systematic the work of writing and sending executable code from the host computer. The programs included enlarge the interactive processing capability of the processing system. Author

N88-24080# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
AUTOMATIC REGISTRATION OF SATELLITE IMAGERY [REGISTRO AUTOMATICO DE IMAGENS DE SATELITE] **c82**
Gilberto Camara Neto *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 669-671 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Registration of satellite imagery is an important need in various application areas in remote sensing. A method is presented for registration which reduces use work to a minimum, the control points being automatically chosen. The method near tests in LANDSAT TM imagery with good results. Author

N88-24081# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
VISUALIZATION OF DIGITAL TERRAIN MODELS [VISUALIZACAO DE MODELOS DIGITAIS DE TERRENO] **c82**
Guaraci Jose Erthal, Carlos Albert Felgueiras, and Joao ArgemirodeCarvalhoPaiva *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 672-674 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The fundamental problem in displaying digital terrain models (DTM) that are tri-dimensional data, is representing them in a bi-dimensional space. Traditional approaches represent DTM data by: contour lines, grey level indexes, and perspective view of a regular grid. First results of a method for rendering tri-dimensional surfaces are presented. This method allows visualization of DTM

combined with other spatial information like satellite imagery.
Author

N88-24082# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
APPLICATION OF ITS TRANSFORMATION IN COLOR ENHANCEMENT OF LANDSAT IMAGERY [APLICADAO DA TRANSFORMACAO IHS PARA REALCE DE CORES EM IMAGENS LANDSAT] **c61**
Luciano Vieira Dutra and Paulo Roberto Meneses *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 675-681 In PORTUGUESE: ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The multispectral color composite imagery, obtained by digital processing and displayed on video monitors through the combination of the fundamental colors (red, green, and blue) consists in an efficient form of presentation. The visual or psychophysiologic perception of the brain to the stimulus of particular colors, tends to combine independently the quantitative components of the fundamental colors, the intensity, (I), hue (H), and saturation (S). So it is possible to perceive each one of these attributes of color, separately. A method is presented to increase the contrast of the colors, using a transformation to the IHS coordinator which permits individual manipulation in each of these components, in order to obtain a better control about the color composite generated in the video display. The basic procedure is a manipulation of the histograms of the components (I, H, and S), in order to increase, decrease, or offset the range of possible values of the components, by linear transformations. The test of this procedure using LANDSAT-TM scene of Serra de Ramalho (BA) showed that different component manipulations resulted in different enhancements of lithologic units, formerly not distinguished in the original color composition, allowed an easier photogeologic interpretation.
Author

N88-24083# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF A FLOOD PERIOD (JUNE, 1984) IN THE SOUTHERN REGION OF LAGUNA DOS PATOS, THROUGH REMOTE SENSING DATA, METEOROLOGICAL AND OCEANOGRAPHIC [AVALICAO DE UM PERIODO DE CHEIA (JUNHO DE 1984) NA REGIAO SUL DA LAGUNA DOS PATOS, ATRAVES DE DADOS DE SENSORIAMENTO REMOTO, METEOROLOGICOS E OCEANOGRAFICOS] **c47**
C. Hartmann, E. E. Sano, R. S. Paz, and O. O. Moeller, Jr. *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 685-694 In PORTUGUESE; ENGLISH summary Prepared in cooperation with Fundacao Univ. do Rio Grande (Brazil). (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Anomalous effects of the meteorological system were caused, from May to July 1984, in the southern region of Brazil, by a great flood period with several consequences of social and economical aspects. This situation in the southern region of Laguna dos Patos was analyzed through remote sensing techniques and meteorological and hydrological data. The evolution of the cyclonic system is described through meteorological synoptic charts and GOES satellite imagery. The influence of the water coming from Laguna Mirim drainage basin through Sao Goncalo Channel and Laguna dos Patos within the studied area was identified and differentiated by the use of automatic analysis of TM imagery of LANDSAT-5 satelllite obtained June 11, 1984, for bands 3 and 5. During this period of extemely strong seaward flow velocities were transferred the mixing area to the adjacent inner shelf zone as shown by hydrological data obtained during the 17th and 18th of June, 1984.
Author

N88-24084# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
RESTRICTIONS IN ACTIVITY MONITORING THROUGH REMOTE SENSING [RESTRICOES EM ATIVIDADES DE MONITORAMENTO POR SENSORIAMENTO REMOTO]
Jose Antonio Mauricio and Thelma Krug *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 695-697 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

From the cloud cover statistics for a specified area, the local solar time and field of view, a simplified formulation is suggested for the probability of success in obtaining useful images about dynamic themes that present distinct phases in certain periods of time. This approach, which considers different remote sensing systems, permits the construction of curves that establish the probability of success in monitoring dynamics themes presenting minimal duration phases.
Author

N88-24085# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DETECTION OF BIOMASS BURNING AND SMOKE PLUMES IN THE AMAZON REGION THROUGH NOAA SATELLITE IMAGERY [DETECCAO DE QUEIMADAS E PLUMAS DE FUMACA NA AMAZONIA ATRAVES DE IMAGENS DOS SATELLITES NOAA]
M. C. Pereira and A. W. Setzer *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 701-709 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Twenty-five NOAA-8 and 9 satellite images covering the Amazon region were recorded from July 19th to August 9th, 1985 and analyzed along with the GTE/ABLE-2A field measurements. The objective was the detection of biomass burnings and smoke plumes to assess the environmental impact caused by their emissions in the atmosphere. The area covered by the smoke varied from 2,800 to 90,000 sq km as the dry season progressed. Maps and slides show the areas affected by the burnings. The methodology proved to be adequate to the detection of large biomass burnings.
Author

N88-24086# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF THE MANGROVE AREA AT THE PIAUI RIVER (SE) THROUGH REMOTE SENSING [AVALIACAO DAS AREAS DE MANGUEZAL DO RIO PIAUI (SE) ATRAVES DE SENSORIAMENTO REMOTO]
Myrian deMouraAbdon, Carmen Regina S. Espindola, Dalton deM. Valeriano, Ernesto GetulioMVieira, Alberto W. Setzer, Auxiliadora Maria Santos, and Yara Schaeffer Novelli (Sao Paulo Univ., Brazil) *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 710-713 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The purpose is to estimate the areas of mangroves at the estuary of the River Piaui (SE) with remote sensing techniques, and also to evaluate any degradation of these areas associated with the growing industrialization in the region. Aerial panchromatic photos in the 1:25,000 scale from December 20, 1984, were used to produce a ground truth map where mangrove areas were identified from other ground cover features. Digital multispectral and multitemporal analysis of MSS/LANDSAT (March 26, 1979) and TM/LANDSAT (July 19, 1984) imagery produced thematic maps of the region, which showed that no significant clearing occurred in the mangrove areas for the 1979 and 1984 period.
Author

N88-24087# Universidade Federal de Parana, Curitiba (Brazil).
THE 35 mm VERTICAL AERIAL PHOTOGRAPHS FOR MAPPING STANDS OF BRACATINGA IN DIFFERENT AGE CLASSES [FOTOGRAFIAS AERAS VERTICAIS 35 MM PARA MAPEAR POVOAMENTOS DE BRACATINGA EM DIFERENTES IDADES] **c35**
Attilio Antonio Disperati, Nelson Carlos Rosot, and Joao RobertodosSantos *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 716-723 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The value of 35 mm vertical aerial photographs used to identify and map Mimosa scabrella Benth (bracatinga) in different age classes is shown. It was possible to differentiate three age classes of bracatinga using the elements of image interpretation. Complemented by field work and dendrometric measurements on the stands, it was possible to discriminate on the photographs of all seven of the different ages of stands in the area. From the resulting photointerpretation map, the area of bracatinga stands in the study area was found. For comparison, the number of bracatinga crowns in plots on 1:3,000 aerial photographs were counted and compared with the data collected in the field. The best results were found for the stands between four to six years of age. Author

N88-24088# Universidad Nacional de San Juan (Argentina).
DUNE FIELDS IN CENTRAL WESTERN ARGENTINA [CAMPOS DE DUNAS EN EL CENTRO-OESTE ARGENTINO] **c46**
Graciela M. Suvires *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 724-732 In SPANISH; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Important accumulations of wind blown sands extend over some sections of plains and pediments. The three dune fields existing in the area are called: Medanos Grandes (great dunes) in the south end of Pie de Palo range between 660 to 750 masl; Las Chacras dune to the southwestern end of Valle Fertil range between 690 to 800 masl; and Mascasin dunes between 450 to 550 masl. These dune fields contain longitudinal, transverse, parabolic, and barchanoid sand dunes with interdune basins. Author

N88-24089# Universidad Nacional de San Juan (Argentina).
THE BREAKED ANTICLINES, CUESTA AND CREST HOMOCLINES, ORTOCLINAL VALLEYS, AND OTHER FORMS OF RELIEF OUTCROPS DELINEATED WITH THE HELP OF REMOTE SENSING IMAGERY [ANTICLINALES APORTILLADOS, CUESTAS Y CRESIAS HOMOCLINALES, VALLES ORIOCLINALES Y OTRAS FORMAS DE RELIEVES PLEGADOS DELIMITADOS CON AYUDA DE IMAGENS DE SENSORES REMOTES]
Graciela M. Suvires *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 733-738 In SPANISH; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

A regional geomorphological map was obtained, in the scale of 1:250,000 from analysis and interpretation of satellite imagery. This map shows many landscapes of relief elaborated over folded outcrops. The Breaked anticlines of Guayaguas-Catantal and Las Quijadas, cuesta and crest homoclinal, orthoclinal, and transversal valley are the main landforms. Author

N88-24090# Universidade Estadual de Paulista, Guaratingueta (Brazil). Departamento de Planejamento Regional.
CURRENT STAGE OF REMOTE SENSING SYSTEM FOR CARTOGRAPHIC APPLICATION [ESTAGIO ATUAL DOS SISTEMAS DE SENSORIAMENTO REMOTO DE APLICACAO CARTOGRAFICA]
M. I. C. deFreitas *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 741-753 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

This work is based upon the need for a better and up-to-date knowledge of existing remote sensing systems or those ready to be activated. The objective is to discuss the principal sensors and cameras with regard to their applications on cartography and photointerpretation. Initially the spatial photogrammetry (LFC, metric camera) is presented followed by the passive imaging systems (LANDSAT, MOMS, TERS, MAPSAT). Next the active imaging systems (RADAR, SLAR, SEASAT, ERS-1, RADARSAT, SIR-A, SIR-B) are shown. A comparative panel of the sensors studied with their main characteristics is presented. Among these characteristics some are mentioned: imaging mode, satellite orbit, height, circle, width of the imaged strip, resolution, possibility for stereoscopic vision, available products, and mapping applications. As a conclusion, the evolution of such systems with respect to accuracy, imaging speed, and the increasing number of different products obtainable was noted. Author

N88-24091# Universidade Federal de Parana, Curitiba (Brazil). Departamento de Silvicultura e Manejo.
STEREOSCOPIC PHOTOGRAPHS, GROUND AND AERIAL, OF TREES USED IN THE ARBORIZATION OF CURITIBA (PR) [FOTOGRAFIAS ESTEROSCOPICAS, TERRESTRES E AEREAS, DE ARVORES UTILIZADAD NA ARBORIZACAO DE CURITIBI - PR] **c35**
Attilio Antonio Disperati and Carlos Vellozo Roderjan *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 757-763 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

This paper deals with the acquisition of 35 mm ground stereo photographs using one camera. The usual trees in the arborization of Curitiba were photographed in two different seasons of the year. Technical and practical aspects related with the acquisition and stereo observation are discussed. The ground stereo-pairs and aerial stereo-pairs, recently acquired from a photogrammetry survey, were introduced in the practical classes of Forest Photointerpretation and Dendrology and the reactions of the students were extremely favorable. Author

N88-24092# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
MAPPING OF PLANT ASSOCIATIONS AND THE VARIATION OF SURFACE WATER IN THE PANTANAL MATO-GROSSENSE NATIONAL PARK, THROUGH REMOTE SENSING TECHNIQUES [MAPEAMENTO DAS FORMACOES VEGETAIS E DA VARIACAO DA LAMINA DAGUA NO PARQUE NACIONAL DO PANTANAL MATO GROSSENSE, ATRAVES DE TECNICAS DE SENSORIAMENTO REMOTO]
Dagoberto Silva and Hermann J. H. Kux *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 764-771 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The objective was to map the plant associations and the variation of the water surface in the Pantanal Mato-grossense National Park, using remote sensng techniques. Color infrared aerial photographs and MSS-LANDSAT digital data were used. Using aerial photographic interpretation techniques, the following vegetation units were identified: semideciduous seasonal alluvial forest, vegetation of transition, and seasonally flooded grasslands. During the digital processing (supervised classification) of the MSS-LANDSAT data, the seasonally flooded grasslands unit was considered as two under classes, due to the relationship between spectral response and soil moisture. The utilization of a SLICER

algorithm at the MSS-LANDSAT 7 band allowed mapping of the area covered with water in flooded and dry seasons. Author

N88-24093# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PRELIMINARY STUDY ON THE APPLICATION OF DIGITAL PROCESSING OF TM-LANDSAT DATA IN THE MAPPING OF APPLE ORCHARDS IN FRAIBURGO (SC) [ESTUDO PRELIMINAR SOBRE A APLICACAO DE PROCESSAMENTO DIGITAL DE DADOS TM-LANDSAT NO MAPEAMENTO DE POMARES DE MACA EM FRAIBURGO, SC]
Jose Roberto Provesi, Dalton deMorisson Valeriano, and Thelma Krug *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 772-784 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

An evaluation of the discriminability of apple orchards from other land uses in the county of Fraiburgo, SC, was attempted through digital analysis of TM-LANDSAT data. The ground truth was a panchromatic aerial survey acquired in September, 1979 (1:20,000) and a ground verification realized in January, 1986; the TM-LANDSAT data (221/79A, December, 1984, bands TM: 2, 3, 4, and 7) were analyzed in the Image-100 System (1:25,000). A hybrid digital classification was employed in the study area. Eight spectral classes were obtained through the K-Means algorithm (non-supervised). These were further divided into eighteen supervised classes by the MAXVER algorithm, comprising eight informative classes: pinus, forest, apple, prepared soil, pasture, water, wetlands, and urban areas. The analysis of the classes localized in the space of attributes TM-3 x TM-4 indicated that the three supervisoned classes for apple overlaped with the forest, pasture, and wetlands classes. These confusions were attributed to differences in the management of the orchards and the age of the apple parcels (from 5 to 20 years). A multitemporal approach, which better explores the phenological characteristics of apple is suggested so as to better discriminate this class from other land uses. Author

N88-24094# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TEMPORAL ANALYSIS OF THE CHANGES IN PARQUE ESTADUAL DE JACUPIRANGA VEGETATION THROUGH DIGITAL TREATMENT OF LANDSAT IMAGERY [ANALISE TEMPORAL DAS ALTERACOES NA NEGETACAO DO PARQUE ESTADUAL DE JACUPIRANGA ATRAVES DE TRATAMENTO DIGITAL DAS IMAGENS LANDSAT]
Pedro Hernandez Filho and Iliana Rajo Saraiva (Instituto Florestal, Sao Paulo, Brazil) *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 785-791 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The main goals were to detect and to estimate the changes of Parque Estadual de Jacupiranga vegetation. The automatic classification of LANDSAT multispectral imagery was made on two dates (July 31, 1973 and August 29, 1983). The Image-100 system was used to extract thematic information and make salient contracts among interested targets through the enhancement technique. A computer program called SUBTRAT was used for correcting the atmospheric scattering and other additive factors. The single cell classification algorithm was used to obtain spectral signatures of a vegetation type and degraded areas. Another computer program called REGMED was used to register two date images. A postclassification technique was used to analyze two images simultaneously. The results show that LANDSAT can be used efficiently for the monitoring of vegetation and degraded areas. Author

N88-24095# Sao Paulo Univ. (Brazil). Escola Superior de Agricultura.
CHARACTERISTICS OF DRAINAGE DETERMINATIONS IN AERIAL PHOTOGRAPHS AND RELIEF DETERMINATION ON DIFFERENT SCALES PLANIALTIMETRIC CHARTS FOR THREE SOILS IN THE STATE OF SAO PAULO [CARACTERISTICAS DA DRENAGEM DETERMINADAS EM FOTOGRAFIAS AEREASE DO RELEVO DETERMINADAS EM CARTAS PLANIALTIMETRICAS DE ESCALAS DIFERENTES PARA TRES SOLOS DO ESTADO DE SAO PAULO]
R. AnguloFilho, V. A. Demetrio, and G. V. deFranca *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 792-798 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Based on the interpretation of vertical aerial photographs on a 1:35,000 scale, the characterization was made of the drainage standards from three different soils of the State of Sao Paulo (red-yellow latosol, red-yellow podzol, and litosol) and the variation was determined for the relief indices obtained from planialtimetric charts on different scales. Each soil unit was represented by three circular samples of 10 sq km. From tracing the drainage networks on the vertical aerial photographs, quantitative indices for the drainage standards were determined for the circular samples. The relief indices were obtained from the circular samples traced on the different scales planialtimetric charts (1:10,000 and 1:50,000). Subsequently, the values for the relief indices obtained from the two charts were compared to determine their variation. Author

N88-24096# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF TM FALSE COLOR COMPOSITES FOR CROP DISCRIMINATION [AVALIACAO DE COMPOSICOES COLIDAS TM FALSA COR PARA A DISCRIMINACAO DE CULTURAS]
Chou Chen Sherry and Angela Maria deLima *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 799-804 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

Visual interpretation of LANDSAT imagery is frequently used in natural resources studies instead of the sophisticated digital analysis which is more expensive and requires expertise. To form false color composites, three LANDSAT bands are needed, generally bands 4, 5, and 7 are used for the 4 band LANDSAT-MSS data. However, the selection of three bands from the available 7 TM bands is not an easy task; because there are 210 possible combinations of the selected three bands with the three prime colors. In this study three different criteria for band selection: entropy, the optimum index factor, and the principal component were used. After band selection, color composites were compared visually to verify discrimination of soybeans, corn, and sugar cane. Study results show that there was no apparent superiorities of visual differentiation among crop types for the color composites selected by any of the studied criteria over the conventional composites using bands 2, 3, and 4. It is concluded that the conventional false color composite should be used for crop discrimination, because no additional training of photointerpreter on the color-surface target relationship is needed. Author

N88-24097# Mineracao Taboca S.A., Manaus (Brazil).
CRITERIA FOR PLANIMETRIC AND ALTIMETRIC CORRECTION OF MAPS RESTITUTED FROM AERIAL PHOTOGRAPHS IN 1:100,000 SCALE [CRITERIOS PARA CORRECAO PLANIMETRICA E ALTIMETRICA DE MAPAS RESTITUIDOS A PARTIR DE FOTOGRAFIAS AEREAS EM ESCALA 1:100000]
Francisco A. Dupas *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 807-811 In

PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The aim is to introduce a simple method for correcting the scale of level curve charts restituted from aerial photographs in a 1:100,000 approximate scale used for planning the Pitinga mine facilities. The mine is located some 250 km north of Manaus (AM-Brazil) and the region displays moderately undulated relief. Through prominences of the relief and geodesic points, topographic surveys are performed so as to allow the determination of the east and north scale of the restituted chart, that later may be amplified or reduced. With a corrected area of 3000 sq km, the drainage maps were already in use for three years and have demonstrated sufficient precision for the general planning of the mine. To trace the level curves a microcomputer and a plotter were used. The original program was in FORTRAN and adapted to BASIC. Author

N88-24098# Universidad Nacional de San Juan (Argentina).
GEOMORPHOLOGIC SECTOR MAPS OF NIQUIZANGA-MAYARES, PROVINCE OF SAN JUAN, ARGENTINA [MAPA GEOMORFOLOGICO SECTOR NIQUIZANGA-MAYARES, PROVINCIA DE SAN JUAN-ARGENTINA]
Graciela M. Suvires *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 812-818 In SPANISH; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

In the investigated area, the plains of the San Juan and Bermejo Rivers are made up by extensive abandoned flood plains characterized by the abundance of winding channels and meanders. After this fluvial action wide extensions of the area were covered by thick aeolian deposits. The alluvial plain of Bermejo River is formed by smaller landforms. Author

N88-24099# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SOME GEOLOGICAL ASPECTS OF THE PIRAPEMAS LINEAMENT BELT [ALGUNS ASPECTOS GEOLOGICOS DO LINEAMENTO PIRAPEMAS]
Jose Eduardo Rodrigues, Chiang Liu Chan, and Fernando PellondeMiranda (Cidade Univ., Rio de Janeiro, Brazil) *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 819-825 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

In LANDSAT and radar images of the Northeast of Maranhao State, numerous lineaments can be perceived and grouped into six main systems by their directions: N45 deg W, N30 deg W, N20 deg E, N70 deg E, N60 deg E, and N50 deg E. Special attention is directed to the latter, of which lineaments are concentrated in a belt, so denominated Pirapemas Lineament Belt. This lineament belt runs from the interfluve between Mearim and Itapicuru hydrographic basins, with an extension of about 200 km, until the Maranhao coastal region, where it is masked by the sand dunes denominated Lencois Maranhenses. From coast landward 70 kilometers, this lineament belt clearly separates the coastal region into two areas with quite different drainage patterns, in spite of the lithological homogeneity. With the comparison of the available tectonic maps, it shows that the Barreirinhas sedimentary basin seems to be affected by the presence of this lineament belt. Author

N88-24100# IBGE/DRN/BA SEPLAN, Salvador (Brazil).
LITHOSTRUCTURAL INTERPRETATION OF CHAPDA DO CACHIMBO (Pa-Am-Mt), BASED ON RADAR AND LANDSAT IMAGERY [INTERPRETACAO LITO-ESTRUTURAL DA CHAPADA DO CACHIMBO (PA-AM-MT), BASEADA EM IMAGENS DE RADAR E LANDSAT]
Mario Ivan CardosodeLima *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 826-839 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

The Cachimbo Plateau is situated at the bordering zones of the states of Para, Amazonas, and Mato Grosso, in the Brazilian Amazon. By using radar (X-band) and MSS LANDSAT (bands 5 and 7) imagery, photogeologic interpretation of the region was performed, and the principal units were identified: metamorphic basement, sedimentary metavolcanic sequence, volcanic-plutonic suite, sedimentary sequence 1, sedimentary sequence 2, basic plutonic 1 and 2, and sedimentary sequence 3. The sedimentary sequence 1 covers do Cachimbo Plateau and was divided into 17 units. Psamitic types dominate the northern portion while in the southwestern sector psamitic-carbonatic ones occur. Regarding the structural aspects, the Cachimbo Plateau comprises a vast basin with WNW-ESE axis. The northern border of the basin is unwarped and presents cuesta features. Folds related to vertical and compressible movements are manifested at the southern sectors and expose interference models. The previsional metalogeny for the Cachimbo Plateau denotes potential deposits of Cu, Co, Ag, U, Fe, Mn, barite, magnesite, diamond, phsophate, limestone, coal, and bauxite. Moreover at the north and south it is limited by two important gold and tin provinces (Tapajos and Floresta-Juruena). Author

N88-24101*# Kansas Univ., Lawrence. Space Technology Center.
RESEARCH ON ENHANCING THE UTILIZATION OF DIGITAL MULTISPECTRAL DATA AND GEOGRAPHIC INFORMATION SYSTEMS IN GLOBAL HABITABILITY STUDIES Final Report, 1986-1987
Edward A. Martinko and James W. Merchant Apr. 1988 138 p (Grant NGL-17-004-024)
(NASA-CR-182799; NAS 1.26:182799) Avail: NTIS HC A07/MF A01 CSCL 08B

During 1986 to 1987, the Kansas Applied Remote Sensing (KARS) Program continued to build upon long-term research efforts oriented towards enhancement and development of technologies for using remote sensing in the inventory and evaluation of land use and renewable resources (both natural and agricultural). These research efforts directly addressed needs and objectives of NASA's Land-Related Global Habitability Program as well as needs of and interests of public agencies and private firms. The KARS Program placed particular emphasis on two major areas: development of intelligent algorithms to improve automated classification of digital multispectral data; and integrating and merging digital multispectral data with ancillary data in spatial modes. B.G.

N88-24102# Research Inst. of National Defence, Stockholm (Sweden).
TERRAIN CLASSIFICATION USING SPOT IMAGES AND THE COMPUTER SYSTEM GOP-300
Matti Svantesson Sep. 1987 50 p In SWEDISH; ENGLISH summary
(FOA-C-20677-2.7; ISSN-0347-3694; ETN-88-92201) Avail: NTIS HC A03/MF A01

For the classification of multispectral images from the SPOT satellite a maximum likelihood algorithm was used. Different contextual analyses were utilized as extra features in the classification, the results of which, with only spectral information as features, was compared with the results when contextual information was used as extra features. Edge-effect is important for fixing the margins. Examples are presented. ESA

N88-24103# Research Inst. of National Defence, Stockholm (Sweden).
PRESENTATION OF MAP INFORMATION ON A COLOR DISPLAY
Lars Jansson Dec. 1987 38 p In SWEDISH; ENGLISH summary

(FOA-C-20687-2.7; ISSN-0347-3694; ETN-88-92202) Avail: NTIS HC A03/MF A01

A computer program was written in Pascal on a VAX-11/750 with a color display, for drawing thematic maps from raster and vector type information. Particularities of the color display were analyzed for making the drawing faster. Functions as the choice of base colors and a selective daubing were implemented. The image quality is good: no color superimposition on the sides and no memory overflow occurs which can destroy the map image on the screen. ESA

N88-24104# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.

COUPLING OF SATELLITE REMOTE SENSING TO DIGITIZED TOPOGRAPHIC MAP TO DETECT CHANGES IN LAND USE Thesis [HET KOPPELEN VAN SATELLIET REMOTE SENSING GEGEVENS AAN EEN GEDIGITALISEERDE TOPOGRAFISCHE KAART OM VERANDERINGEN IN GRONDGEBRUIK TE DETEKTEREN]

L. F. Verheij Nov. 1987 65 p In DUTCH; ENGLISH summary (B8735129; ETN-88-92418) Avail: NTIS HC A04/MF A01

Images from LANDSAT Thematic Mapper were coupled to a 1:25,000 map to aid planning and environment management. By digitizing the analog map, a vector-file is created which consists of closed polygons. The lines of a polygon represent edges of roads and waterways, boundaries of urban areas, and boundaries of parcels in rural areas. Within one polygon the land use is homogeneous. Land use, as drawn in the map, is added to this file. A database is set up to record the relationship between the land use and the polygons. The vector file is projected on the satellite image by a similarity-transformation, after which for each polygon the class which is most represented by the labelled pixels is computed. Based upon decision rules, this class describes the actual land use. The coupling is executed and the found modifications of the land use are recorded in the database. The combination of the digital map and the satellite image assures good geometry with up to date thematic content. It can be regarded as a base for a geographic information system, although for this the geometry and the precision of the classification of satellite imagery need to be improved. ESA

N88-24105# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.

ADJUSTMENT IN PHOTOGRAMMETRY: METHODS, PROGRAMS AND APPLICATIONS Thesis [BLOKVEREFFENING IN DE FOTOGRAMMETRIE: METHODEN, PROGRAMMATUUR EN TOEPASSINGEN]

F. Detmar Nov. 1987 115 p In DUTCH; ENGLISH summary (B8735130; ETN-88-92419) Avail: NTIS HC A06/MF A01

Adjustment programs and the application of nonphotogrammetric information in photogrammetry are discussed. The nonphotogrammetric data are from control objects, the Global Positioning System, and auxiliary data from horizon camera, statoscope, and the airborne profile recorder. Aerotriangulation and adjustment procedures are described with regard to the method with independent models and the method with bundles. Test procedures and error search methods such as data snooping and robust estimation are considered. Precision of the method with bundles is better than the method with independent models. For both methods the reliability measures are in good agreement with each other. The application of additional parameters is easy to manage for the bundle method in contrast with the method with independent models. Additional parameters seem not to be necessary for the method with independent models, because this method is insensitive to systematic errors. Auxiliary data only seem sufficient for small scale projects. The Global Positioning System might be used to determine terrain control point coordinates as well as to determine the projection center coordinates which can also be used as control points. ESA

N88-24106# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.

DIGITAL MONOPLOTTING, PART 1 Thesis

E. J. vanderEnt Jul. 1987 100 p In DUTCH; ENGLISH summary (B8735122-Pt-1; ETN-88-92421) Avail: NTIS HC A05/MF A01

A digital monoplotting program to update data bases from a single aerial photograph was written. The program is used for a digital terrain model (DTM) used to produce artificial radar images for flight simulators. The DTM has to be transformed to the photograph and displayed on the screen of the interactive system. The program computes the transformation parameters from control points and fiducial marks by the least squares method, followed by testing procedures, and enables the transformation from terrain to photograph and reverse. Flat horizontal terrain can be described by a single reference height, flat rising terrain by a bilinear function of the planimetric terrain coordinates, while all types of terrain can be represented by a digital height model. Interpolation within the height array can be done by the nearest neighbor method or a 4-term bilinear polynomial interpolation. Two methods are developed for the correction of the relief displacement; if one method fails the program automatically switches to the other method. For the estimation of the precision and reliability of the transformed digitized points, the program uses eight test points. Precision is described by the standard deviation of the transformed points in the terrain and reliability by their boundary values. ESA

N88-24107# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.

DIGITAL MONOPLOTTING, PART 2 Thesis

E. J. vanderEnt Jul. 1987 88 p

(B8735122-Pt-2; ETN-88-92422) Avail: NTIS HC A05/MF A01

A digital monoplotting program to update data bases from a single aerial photograph was written. The program is used for a digital terrain model (DTM) used to produce artificial radar images for flight simulators. The DTM has to be transformed to the photograph and displayed on the screen of the interactive system. The program computes the transformation parameters from control points and fiducial marks by the least squares method, followed by testing procedures, and enables the transformation from terrain to photograph and reverse. Flat horizontal terrain can be described by a single reference height, flat rising terrain by a bilinear function of the planimetric terrain coordinates, while all types of terrain can be represented by a digital height model. Interpolation within the height array can be done by the nearest neighbor method or a 4-term bilinear polynomial interpolation. Two methods are developed for the correction of the relief displacement; if one method fails the program automatically switches to the other method. For the estimation of the precision and reliability of the transformed digitized points, the program uses eight test points. Precision is described by the standard deviation of the transformed points in the terrain and reliability by their boundary values. ESA

N88-24108# Science Applications International Corp., McLean, Va.

SOVIET REMOTE SENSING RESEARCH AND TECHNOLOGY

P. N. Slater, R. R. P. Chase, R. S. Fraser, F. E. Hoge, J. C. Price, and G. J. Zissis Feb. 1988 226 p

(FASAC-TAR-3130) Avail: NTIS HC A11/MF A01

This review of Soviet civilian remote sensing research and technology is based mainly on literature published by Soviet scientists and to a much smaller extent on information contained in Soviet press releases and elsewhere. An overall assessment of Soviet research and technology in remote sensing is provided. The sensors, methodologies, and results of the Soviet remote sensing program in the solar reflective, thermal infrared, and microwave regions of the electromagnetic spectrum are examined. Also discussed is the Soviet work in data handling and information extraction. The general conclusion is that the United States leads the Soviet Union by about five years in most areas of remote sensing research and technology. This lead is mainly the result of the superior microelectronics technology and computing capability of the United States, particularly with regard to the telemetry and

processing of large quantities of high-quality, satellite-acquired, digital image data--the starting point for most Western research and application studies in remote sensing. Author

N88-24109*# Pennsylvania State Univ., University Park. Dept. of Meteorology.
AN UPDATE ON REMOTE MEASUREMENT OF SOIL MOISTURE OVER VEGETATION USING INFRARED TEMPERATURE MEASUREMENTS: A FIFE PERSPECTIVE
Semiannual Status Report, Mar. 1987 - Mar. 1988
Toby N. Carlson Jun. 1988 29 p
(Grant NAG5-919)
(NASA-CR-182926; NAS 1.26:182926) Avail: NTIS HC A03/MF A01 CSCL 08B

Using model development, image analysis and micrometeorological measurements, the object is to push beyond the present limitations of using the infrared temperature method for remotely determining surface energy fluxes and soil moisture over vegetation. Model development consists of three aspects: (1) a more complex vegetation formulation which is more flexible and realistic; (2) a method for modeling the fluxes over patchy vegetation cover; and (3) a method for inferring a two-layer soil vertical moisture gradient from analyses of horizontal variations in surface temperatures. HAPEX and FIFE satellite data will be used along with aircraft thermal infrared and solar images as input for the models. To test the models, moisture availability and bulk canopy resistances will be calculated from data collected locally at the Rock Springs experimental field site and, eventually, from the FIFE project. Author

N88-24011# Meteorological Satellite Center, Tokyo (Japan).
ENHANCED INFRA-RED PICTURE OF LR-FAX FOR SPRING AND AUTUMN SEASONS
Saya Kurino *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 75-79 In JAPANESE; ENGLISH summary (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N88-24110*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ECUT (ENERGY CONVERSION AND UTILIZATION TECHNOLOGIES) PROGRAM: BIOCATALYSIS PROJECT
Annual Report, FY 1987
30 Mar. 1988 36 p
(Contract NAS7-918)
(NASA-CR-182917; JPL-Publ-88-8; NAS 1.26:182917; DOE/CS-66001/11) Avail: NTIS HC A03/MF A01 CSCL 10A

Fiscal year 1987 research activities and accomplishments for the Biocatalysis Project of the U.S. Department of Energy, Energy Conversion and Utilization Technologies (ECUT) Division are presented. The project's technical activities were organized into three work elements. The Molecular Modeling and Applied Genetics work element includes modeling and simulation studies to verify a dynamic model of the enzyme carboxypeptidase; plasmid stabilization by chromosomal integration; growth and stability characteristics of plasmid-containing cells; and determination of optional production parameters for hyper-production of polyphenol oxidase. The Bioprocess Engineering work element supports efforts in novel bioreactor concepts that are likely to lead to substantially higher levels of reactor productivity, product yields, and lower separation energetics. The Bioprocess Design and Assessment work element attempts to develop procedures (via user-friendly computer software) for assessing the economics and energetics of a given biocatalyst process. Author

N88-24111*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THREE-DIMENSIONAL MODELS OF CONVENTIONAL AND VERTICAL JUNCTION LASER-PHOTOVOLTAIC ENERGY CONVERTERS
John H. Heinbockel and Gilbert H. Walker Jul. 1988 21 p
(Grant NAG1-148)
(NASA-TM-4039; L-16424; NAS 1.15:4039) Avail: NTIS HC A03/MF A01 CSCL 10A

Three-dimensional models of both conventional planar junction and vertical junction photovoltaic energy converters have been constructed. The models are a set of linear partial differential equations and take into account many photoconverter design parameters. The model is applied to Si photoconverters; however, the model may be used with other semiconductors. When used with a Nd laser, the conversion efficiency of the Si vertical junction photoconverter is 47 percent, whereas the efficiency for the conventional planar Si photoconverter is only 17 percent. A parametric study of the Si vertical junction photoconverter is then done in order to describe the optimum converter for use with the 1.06-micron Nd laser. The efficiency of this optimized vertical junction converter is 44 percent at 1 kW/sq cm. Author

N88-24255*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OVERVIEW OF NASA LEWIS RESEARCH CENTER FREE-PISTON STIRLING ENGINE TECHNOLOGY ACTIVITIES APPLICABLE TO SPACE POWER SYSTEMS
Jack G. Slaby *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 1-6
(For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 10B

N88-24258*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPECULATIONS ON FUTURE OPPORTUNITIES TO EVOLVE BRAYTON POWERPLANTS ABOARD THE SPACE STATION
Robert E. English *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 15-18 Previously announced as N87-23674 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 10B

N88-24310# GA Technologies, Inc., San Diego, Calif.
A REVIEW OF THERMIONIC POWER CONVERSION SYSTEMS FOR SDI APPLICATIONS
Richard C. Dahlberg, Fred Huffman, and Richard Brehm (Rasor Associates, Inc., Sunnyvale, Calif.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 241-244 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24312# Oak Ridge National Lab., Tenn.
ASSESSMENT OF ENERGY STORAGE CONCEPTS FOR USE IN SPRINT POWER
M. Olszewski and D. G. Morris *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 249-252 (For primary document see N88-24254 17-73)
(Contracts MIPR-FY-1455-85-N0617; MIPR-FR-1455-85-N0632; MIPR-FY-1455-86-N0615)
Avail: NTIS HC A22/MF A01

N88-24313# Argonne National Lab., Ill.
MONOLITHIC FUEL CELL BASED POWER SOURCE FOR SPRINT POWER GENERATION
D. C. Fee, D. E. Busch, D. W. Dees, J. Dusek, T. E. Easler, W. A. Ellingson, B. K. Flandermeyer, R. J. Fousek, J. J. Heiberger, and S. Majumdar et al. *In* New Mexico Univ., Transactions of the

Fourth Symposium on Space Nuclear Power Systems 1987 p 253-255 (For primary document see N88-24254 17-73)
(Contract W-31-109-eng-38)
Avail: NTIS HC A22/MF A01

N88-24324*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AMTEC ELECTRODE DEVELOPMENT
C. P. Bankston, R. M. Williams, B. J. Nakamura, B. L. Wheeler, M. E. Loveland, and T. Cole *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 299-301 Sponsored by NASA, Washington, D.C. and Space Defense Initiative Organization, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 18K

N88-24325# Ford Motor Co., Dearborn, Mich.
SODIUM HEAT ENGINE/AMTEC SYSTEM EXPERIMENTS
T. K. Hunt, J. V. Lasecki, R. F. Novak, J. R. McBride, and J. T. Brockway *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 305-307 (For primary document see N88-24254 17-73)
(Contract DE-AC02-83CE-40651)
Avail: NTIS HC A22/MF A01

N88-24334# Toledo Univ., Ohio. Dept. of Mechanical Engineering.
TRANSIENT ANALYSIS OF LI AND LIH THERMAL STORAGE SPHERES
Douglas L. R. Oliver *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 343-346 (For primary document see N88-24254 17-73)
(Contract F49620-85-C-0013)
Avail: NTIS HC A22/MF A01

N88-24349# Martin Marietta Energy Systems, Inc., Oak Ridge, Tenn.
NUCLEAR RANKINE/FLYWHEEL MMW SPACE POWER CONCEPT
J. P. Nichols, R. S. Holcomb, J. C. Moyers, and D. U. OKain *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 415-418 (For primary document see N88-24254 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A22/MF A01

N88-24384# Argonne National Lab., Ill.
THERMAL AND POWER AVAILABILITY TRANSIENT RESPONSES FOR THE ARGONNE MONOLITHIC SOLID OXIDE FUEL CELL
Nelson A. Hanan and Larry W. Carlson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 41-44 Sponsored by Strategic Defense Initiative Organization, Washington, D.C., DOE, Washington, D.C. and Defense Advanced Research Projects Agency, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24401# Garrett Fluid Systems Co., Tempe, Ariz.
CHARACTERISTICS OF THE CLOSED BRAYTON CYCLE FOR DYNAMIC ISOTOPE POWER SYSTEMS
Bradley C. Litz *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 131-134 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24402# Sundstrand Corp., Rockford, Ill.
STATUS OF THE ORGANIC RANKINE CYCLE FOR SPACE APPLICATIONS
T. J. Bland, P. D. Lacey, and G. L. Sorensen *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 135-138 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24407*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
OPTIMIZATION OF ORGANIC RANKINE CYCLES FOR SPACE STATION APPLICATIONS
Dana L. Eubanks, Frederick R. Best (Texas A&M Univ., College Station.), and Nanette Faget *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 159-162 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 10B

N88-24421# Grumman Aerospace Corp., Bethpage, N.Y. Space Systems Div.
DYNAMIC ISOTOPE POWER SYSTEM CRITICAL COMPONENT VERIFICATION
Richard J. Pearson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 233-236 (For primary document see N88-24374 17-73)
(Contract F04701-85-C-0090)
Avail: NTIS HC A99/MF A01

N88-24422# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
SNAP-DYN: PROVEN TECHNOLOGY FOR WEAR-TERM, HIGHER POWER IN SPACE
Richard A. Johnson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 239-242 Sponsored in part by Atomic Energy Commission, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24430# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
ENERGY STORAGE EVALUATION FOR BURST POWER APPLICATIONS
John W. Meisner and Kenneth J. Metcalf *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 283-286 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24431# Oak Ridge National Lab., Tenn.
ENERGY STORAGE FOR NUCLEAR BURST POWER SYSTEMS
Mitchell Olszewski and David G. Morris *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 287-290 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24432# Oak Ridge National Lab., Tenn.
VALUE ASSESSMENT OF ENERGY STORAGE CONCEPTS IN BURST POWER SYSTEMS
Moshe Siman-Tov, Mitchell Olszewski, and David E. Klett (North Carolina Agricultural and Technical State Univ., Greensboro.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 291-294 Previously announced as N88-17115 (For primary document see N88-24374 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A99/MF A01

N88-24433# Westinghouse Electric Corp., Sunnyvale, Calif.
ROTATING-HOOP, PULSED-ENERGY CONVERTER
Bobby D. McKee *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 295-298 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24434# TRW Defense and Space Systems Group, Redondo Beach, Calif.
CANDIDATE ADVANCED ENERGY STORAGE CONCEPTS FOR MULTIMEGAWATT BURST POWER SYSTEMS
John E. Boretz and Charles Sollo *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 299-302 (For primary document see

N88-24374 17-73)
(Contract F27601-86-C-0214)
Avail: NTIS HC A99/MF A01

N88-24440# Orion International Technologies, Albuquerque, N. Mex.
SPACE POWER REFERENCE SOURCE (SPRS): A USER'S GUIDE TO SDI SPACE POWER TECHNOLOGY PROGRAMS
L. B. Latham *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 325-328 (For primary document see N88-24374 17-73)
(Contract F29601-85-C-0060)
Avail: NTIS HC A99/MF A01

N88-24450# Argonne National Lab., Ill.
MONOLITHIC FUEL CELL BASED POWER SOURCE FOR BURST POWER GENERATION
D. C. Fee, P. E. Blackburn, D. E. Busch, D. W. Dees, J. Dusek, T. E. Easler, W. A. Ellingson, B. K. Flandermeyer, R. J. Fousek, and J. J. Heiberger et al. *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 369-373 Sponsored by Strategic Defense Initiative Organization, Washington, D.C., DOE, Washington, D.C. and Defense Advanced Research Projects Agency, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24451# United Technologies Corp., South Windsor, Conn. Power Systems Div.
HIGH POWER DENSITY ALKALINE FUEL CELL TECHNOLOGY FOR MMW SPACE BURST POWER
J. Lawrence Preston, Jr., John C. Trocciola, and Ronald J. Wertheim (International Fuel Cells Corp., South Windsor, Conn.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 375-378 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24452# Los Alamos National Lab., N. Mex.
POLYMER FUEL CELL AS AN ENERGY STORAGE COMPONENT FOR SPACE POWER APPLICATIONS
Carmelo A. Spirio and Nicholas E. Vanderborgh *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 381-383 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24469*# Sundstrand Corp., Rockford, Ill.
EXPERIMENTAL DEMONSTRATIONS OF ORGANIC RANKINE CYCLE WASTE HEAT REJECTION SYSTEMS
Timothy J. Bland and P. Douglas Lacey *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 461-463 Sponsored by NASA, Lyndon B. Johnson Space Center, Houston, Tex., NASA, Lewis Research Center, Cleveland, Ohio and Grumman Aerospace, Bethpage, N.Y. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 10B

N88-24476# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
POTASSIUM RANKINE POWER SYSTEM FOR SPACE POWER
E. B. Baumeister and William R. Determan *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 495-498 (For primary document see N88-24374 17-73)
(Contract ORNL-IIX-02207V)
Avail: NTIS HC A99/MF A01

N88-24488# Garrett Fluid Systems Co., Tempe, Ariz.
THE CLOSED BRAYTON CYCLE: AN ENERGY CONVERSION SYSTEM FOR NEAR-TERM MILITARY SPACE MISSIONS
Keith A. Davis *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 561-564 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24489# Sandia National Labs., Albuquerque, N. Mex.
THE EFFECT OF OPERATING TEMPERATURE AND TURBINE BLADE COOLING ON BRAYTON CYCLE SPACE POWER SYSTEMS
Michael W. Edenburn *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 565-570 (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01

N88-24490# Pacific Northwest Labs., Richland, Wash.
A COMBINED RANKINE/BRAYTON PULSE POWER CYCLE
Edmund P. Coomes, Benjamin M. Johnson, and Herbert J. Bomelburg *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 571-574 (For primary document see N88-24374 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A99/MF A01

N88-24492# New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
ENERGY CONVERSION SYSTEM OPTIMIZATION STUDY FOR MULTIMEGAWATT SPACE NUCLEAR POWER APPLICATION
Alexander G. Parlos, Mohamed S. El-Genk, John M. McGhee, David Buden, and Jim Mims (Science Applications International Corp., Albuquerque, N. Mex.) *In its* Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 579-582 (For primary document see N88-24374 17-73)
(Contract DE-AC03-86SF-16508)
Avail: NTIS HC A99/MF A01

N88-24499# Westinghouse Electric Corp., Madison, Pa. Advanced Energy Systems Div.
ALKALI METAL THERMOELECTRIC CONVERTER DESIGN FOR SPACE POWER SYSTEMS APPLICATIONS
Robert K. Sievers, Robert A. Markley, J. Edward Schmidt, Neill Weber, James R. Rasmussen, Scott Olsen, and Thomas K. Hunt (Ford Motor Co., Dearborn, Mich.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 615-618 (For primary document see N88-24374 17-73)
(Contract DE-AC03-86SF-16503)
Avail: NTIS HC A99/MF A01

N88-24500# Thermacore, Inc., Lancaster, Pa.
A CAPILLARY PUMPED SHE/AMTEC SYSTEM
Donald M. Ernst *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 619-620 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24502# Ford Motor Co., Dearborn, Mich.
PERFORMANCE OF VAPOR-FED SODIUM HEAT ENGINE/AMTEC SYSTEMS
Robert F. Novak, James R. McBride, and Thomas K. Hunt *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 625-628 (For primary document see N88-24374 17-73)
(Contract DE-AC02-83CE-40651)
Avail: NTIS HC A99/MF A01

N88-24503*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
IMPROVED GaP DOPED SiGe THERMOELECTRIC MATERIAL
Jan W. Vandersande, Charles Wood, Susan L. Draper, Valvo Raag, Michael Alexander, and Richard Masters (Thermo Electron Corp., Waltham, Mass.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 629-632 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 10A

N88-24504# Sandia National Labs., Albuquerque, N. Mex.
MULTIMEGAWATT POWER CONDITIONING REQUIREMENTS STUDY
David T. Furgal and William H. McCulloch *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 637-641 (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N88-24112*# Institut d'Aeronomie Spatiale de Belgique, Brussels.
THE POTENTIAL IMPACT ON ATMOSPHERIC OZONE AND TEMPERATURE OF INCREASING TRACE GAS CONCENTRATIONS
G. Brasseur and A. DeRudder 1987 100 p Sponsored in cooperation with the Belgian National Fund for Scientific Research and NSF
(NASA Order W-16215; EEC-85-B6602-11-010-11-N)
(NASA-CR-182965; NAS 1.26:182965;
Aeronomica-Acta-A-322-1987; ISSN-0065-3713; ETN-88-92484)
Avail: NTIS HC A05/MF A01 CSCL 13B

The response of the atmosphere to emissions of chlorofluorocarbons (CFCs) and other chlorocarbons, and to increasing concentrations of other radiatively active trace gases such as CO2, CH4, and N2O is calculated by a coupled chemical-radiative transport one-dimensional model. It is shown that significant reductions in the ozone concentration and in the temperature are expected in the upper stratosphere as a result of increasing concentrations of active chlorine produced by photodecomposition of the CFCs. The ozone content is expected to increase in the troposphere, as a consequence of increasing concentrations of methane and nitrogen oxides. Due to enhanced greenhouse effects, the Earth's surface should warm up by several degrees. The amplitude and even the sign of future changes in the ozone column are difficult to predict as they are strongly scenario-dependent. An early detection system to prevent noticeable ozone changes as a result of increasing concentrations of source gases should thus be based on a continuous monitoring of the ozone amount in the upper stratosphere rather than on measurements of the ozone column only. Measurements of NOx, Clx, and HOx are also required for unambiguous trend detection and interpretation. ESA

N88-24113*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EFFECTS OF NATURAL ENVIRONMENT ON FIRST GENERATION SOLID ROCKET BOOSTER THERMAL PROTECTION SYSTEM MATERIALS
D. D. Webb Apr. 1988 19 p
(NASA-TM-100329; NAS 1.15:100329) Avail: NTIS HC A03/MF A01 CSCL 13B

The effort to demonstrate, by real-time exposure, the effects of the natural environment at Kennedy Space Center, Florida, upon the Thermal Protection System (TPS) of the Solid Rocket Booster (SRB) is summarized, and that the overall SRB TPS configuration is verified to meet all requirements for resistance to the conditions associated with outdoor weathering, including: solar radiation; temperature; humidity; precipitation; wind; sand/dust abrasion; static electricity; salt spray; fungus; and atmospheric oxidants. The evaluation criterion for this project was based upon flatwise tensile properties, visual inspection, color change, and thermal performance. Based upon the evaluation of the changes in these properties, it is concluded that properly applied and topcoat-protected TPS can satisfactorily withstand the conditions of the natural environment at KSC for exposures up to six months. Author

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N88-24114# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
SPECIFIC FEATURES OF EMANATION, TEMPERATURE AND HYDRODYNAMIC FIELDS IN THE EPICENTRAL ZONE OF TECTONIC EARTHQUAKE
T. A. Ashirov, D. Ishankuliev, G. A. Ishankuliev, L. V. Dzholos, K. I. Merkina, and S. P. Tretyakova 1986 6 p In RUSSIAN; ENGLISH summary
(DE88-701140; JINR-18-86-708) Avail: NTIS HC A02/MF A01

The random field variation in loose deposits from the zone of the Cheleken-Kum-Dag fracture due to an earthquake with M = 5.6 was studied using the nuclear track technique. The complex analysis of the variations of emanation, temperature and hydrodynamical fields was carried out. Abnormal changes in all the three fields during the Burun earthquake have been found, due to changes in the rock structure of the central zone. DOE

N88-24115# Naval Postgraduate School, Monterey, Calif.
SKY RADIANCE DISTRIBUTIONS FOR THERMAL IMAGING BACKGROUNDS M.S. Thesis
Apostolos Kotsis Dec. 1987 137 p
(AD-A191135; AD-E500916) Avail: NTIS HC A07/MF A01 CSCL 04A

The Background Measurements and Analysis Program (BMAP) is a program of measurement and analysis of background scenes appropriate to generic infrared imaging systems. A computer code has been made available to NACIT (Naval Academic Center for Infrared Technology). This code includes two stored measurement data sets for 2 dimensional Fast Fourier Transform comparison and other processing techniques, a version of LOWTRAN propagation code and high resolution graphics. This thesis is the evaluation of this code for use to provide test data sets to the IRSTD data processing/acquisition system, the evaluation of AGA DISCO program for use with the BMAP, the evaluation of the present IRSTD/MASSCOMP system for use with the BMAP and the transfer of the extracted BMAP data sets, obtained during an experiment to the Masscomp computer of the IRSTD system in IRSTD data form. GRA

N88-24116# Service Hydrographique et Oceanographique de la Marine, Paris (France). Section Geodesie-Geophysique.
EVALUATION OF A MODEL OF THE EARTH'S GRAVITY FIELD [EVALUATION D'UN MODELE DU CHAMP DE PESANTEUR TERRESTRE]
Alain Fourgassie 8 Apr. 1987 36 p In FRENCH
(Contract A-85-76-301)
(EPSHOM-003/87; ETN-88-92160) Avail: NTIS HC A03/MF A01

A model of the Earth's gravitational field was compared with ocean gravimetry data as part of the development of a satellite based system for ocean localization. Results show that model accuracy is: geoid 30 to 40 cm; gravity anomaly 10 to 15 mgals; and vertical deviation component less than 5 sec. The GEOS 3 satellite gives a good altimetric density profile for latitudes below 65 deg, but its altimeter is not accurate enough. SEASAT gives accurate altimetric measurements, but its orbit is not known with the same level of accuracy. The TOPEX-POSEIDON and ERS-1 (ESA) satellites should allow the model to be refined to give decimeter accuracy for the geoid at wavelengths under 100 km. GEOSAT may also be useful, but its data are classified. Until these satellites become operational, the use of the model with ocean gravimetry can give 5 sec accuracy even in perturbed gravimetric zones. ESA

N88-24117# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
THE DETERMINATION OF GRAVITY AND TOPOGRAPHY FROM SEISMIC VELOCITIES, ACCOUNTING FOR DYNAMIC BEHAVIOR OF THE EARTH'S MANTLE Thesis
P. L. Smilde Jun. 1987 203 p Original contains color illustrations
(ETN-88-92420) Avail: NTIS HC A10/MF A01

Determination of density distribution in the Earth's mantle using geophysical and geodetic techniques is considered. The results of the computation of the geoid (degree 2 to 6), just by propagating the gravity effect of tomographic density observations, shows a negative correlation with the observed geoid (except degree 4). Using dynamic response functions (including the flow effects) as defined by Ricard et al (1984) results in relatively high positive correlations (except degree 4), but the differences between various models are not small, especially concerning amplitude. However, models can result in a very good resemblance with the observed geoid and can explain (with help of dynamic response theory) features of the observed geoid which were unexplained. The computed topography (degree 2 to 6) resulting from the flow seems to be very likely in general, but could not be verified by observations. ESA

N88-24118*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NON-NEWTONIAN GRAVITY OR GRAVITY ANOMALIES?
David P. Rubincam, B. Fong Chao, Kenneth H. Schatten, and William W. Sager (Texas A&M Univ., College Station.) Jun. 1988 9 p
(NASA-TM-4030; Rept-88B0104; NAS 1.15:4030) Avail: NTIS HC A02/MF A01 CSCL 08G

Geophysical measurements of G differ from laboratory values, indicating that gravity may be non-Newtonian. A spherical harmonic formulation is presented for the variation of (Newtonian) gravity inside the Earth. Using the GEM-10B Earth Gravitational Field Model, it is shown that long-wavelength gravity anomalies, if not corrected, may masquerade as non-Newtonian gravity by providing significant influences on experimental observation of delta g/delta r and G. An apparent contradiction in other studies is also resolved: i.e., local densities appear in equations when average densities of layers seem to be called for. Author

N88-24119 Pennsylvania State Univ., University Park.
ON REGIME SELECTION IN GLOBAL ATMOSPHERIC FLOW Ph.D. Thesis
Raymond Wayne Higgins 1987 294 p
Avail: Univ. Microfilms Order No. DA8728015

The possibility of global-scale atmospheric regime transitions for small changes in the forcing is investigated with a nonlinear, spherical spectral model. Low-order versions of this model are used both to calculate two- and three-dimensional Hadley states and to determine their stabilities to certain three-dimensional baroclinic disturbances of any zonal wavenumber. The flow is forced by an idealized heating pattern based on atmospheric data, and is dissipated using an eddy viscosity formulation. The asymmetry components are chosen so that the model retains the same general form for certain sets of longitudinal and latitudinal wavenumbers. When all combinations of heating and rotation rates are considered, a transition curve separating the ideal Hadley and Rossby regimes is found. For applications of the results to the atmosphere, an equilibrium curve in heating parameter space is used. Asymmetric forcing drives the modified Hadley states, which capture certain fundamental features of the observed tropospheric circulation. Results suggest that the Hadley-Rossby transition would be expected to occur in the atmosphere. However, the sensitivity of the preferred zonal wavenumbers to the values of the external parameters in the model suggests that small changes in the corresponding atmospheric parameters might result in large changes in the global climate. Dissert. Abstr.

N88-24120*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CENTRIFUGAL ACCELERATION OF IONS IN THE POLAR MAGNETOSPHERE
Kenneth R. Swinney, James L. Horwitz (Alabama Univ., Huntsville.), and D. Delcourt Mar. 1987 36 p Submitted for publication
(NASA-TM-101148; NAS 1.15:101148) Avail: NTIS HC A03/MF A01 CSCL 04A

The transport of ionospheric ions originating near the dayside cusp into the magnetotail is parametrically studied using a 3-D model of ion trajectories. It is shown that the centrifugal term in the guiding center parallel force equation dominates the parallel motion after about 4 Re geocentric distance. The dependence of the equatorial crossing distance on initial latitude, energy and convection electric field is presented for ions originating on the dayside ionosphere in the noon-midnight plane. It is also found that up to altitudes of about 5 Re, the motion is similar to that of a bead on a rotating rod, for which a simple analytical solution exists. Author

N88-24121*# Science and Technology Corp., Hampton, Va.
SAGE 1 AND SAM 2 MEASUREMENTS OF 1 MICRON AEROSOL EXTINCTION IN THE FREE TROPOSPHERE
G. S. Kent, U. O. Farrukh, P. H. Wang, and A. Deepak [1988] 30 p Submitted for publication
(Contract NAS8-35594)
(NASA-CR-182945; NAS 1.26:182945) Avail: NTIS HC A03/MF A01 CSCL 04A

The SAGE 1 and SAM 2 satellite sensors were designed to measure, with global coverage, the 1 micron extinction produced by the stratospheric aerosol. In the absence of high altitude cloud, similar measurements may be made for the free tropospheric aerosol. Median extinction values in the Northern Hemisphere, for altitudes between 5 and 10 km, are found to be one-half to one order of magnitude greater than values at corresponding latitudes in the Southern Hemisphere. In addition, a seasonal increase by a factor of 1.5 yields 2 is observed in both hemispheres in local spring and summer. Following major volcanic eruptions, a long-lived enhancement of the aerosol extinction is observed for altitudes above 5 km. Author

N88-24006# Meteorological Satellite Center, Tokyo (Japan).
ESTIMATION OF TOTAL OUTGOING LONGWAVE RADIATION (OLR) FLUX FROM GEOSTATIONARY METEOROLOGICAL SATELLITE INFRARED WINDOW RADIANCE
Toshiyuki Kurino and Akihiro Uchiyama *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 21-32 (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

N88-24007# Meteorological Satellite Center, Tokyo (Japan).
OUTLINE OF THE GPCP STRATEGY
Toshiyuki Kurino *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 33-38 In JAPANESE; ENGLISH summary (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

N88-24088# Universidad Nacional de San Juan (Argentina).
DUNE FIELDS IN CENTRAL WESTERN ARGENTINA [CAMPOS DE DUNAS EN EL CENTRO-OESTE ARGENTINO]
Graciela M. Suvires *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 724-732 In SPANISH; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N88-24122# University of Southern California, Los Angeles. Center for Earth Sciences.
OBSERVATIONS OF FRONTAL INSTABILITIES ON AN UPWELLING FILAMENT
Libe Washburn and Laurence Armi 1987 64 p
(Contract N00014-87-K-0220)
(AD-A191051) Avail: NTIS HC A04/MF A01 CSCL 08C

Frontal instabilities were observed along a density front on the cyclonic boundary of an upwelling filament which formed north of Pt. Arguello, California in October 1983. Observations of the instabilities were conducted using satellites sea surface temperature images and in situ sampling. The instabilities formed on the southern (cyclonic) boundary of the filament at a wavelength of about 20 km and consisted of two lobes, one warm and one cool, each with a width of about 4 km. The time scale for formation of the instabilities is about 1 day. Near surface distributions of temperature, salinity, and density within the cool lobes of the instabilities are consistent with local upwelling at the rate of about 30 m/d. A simple model based on conservation of potential vorticity is presented which accounts for the observed upwelling. Based on isopycnal displacements and the distribution of salinity, the signature of the instabilities appears to be confined to the upper 50 m of the water column. GRA

N88-24123*# Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Sciences.
CLOUD COVER DETERMINATION IN POLAR REGIONS FROM SATELLITE IMAGERY Semiannual Report
R. G. Barry, J. R. Key, and J. A. Maslanik 15 Jun. 1988 53 p
(Grant NAG5-898)
(NASA-CR-182906; NAS 1.26:182906) Avail: NTIS HC A04/MF A01 CSCL 04B

The principal objectives of this project are: to develop suitable validation data sets to evaluate the effectiveness of the ISCCP operational algorithm for cloud retrieval in polar regions and to validate model simulations of polar cloud cover; to identify limitations of current procedures for varying atmospheric surface conditions, and to explore potential means to remedy them using textural classifiers: and to compare synoptic cloud data from a control run experiment of the Goddard Institute for Space Studies (GISS) climate model 2 with typical observed synoptic cloud patterns. Current investigations underway are listed and the progress made to date is summarized. Author

N88-24124 Pennsylvania State Univ., University Park.
FINITE ELEMENT SIMULATION OF THE ATMOSPHERE'S ELECTROMAGNETIC RESPONSE TO CHARGE PERTURBATIONS ASSOCIATED WITH LIGHTNING Ph.D. Thesis
Michael Edward Baginski 1987 122 p
Avail: Univ. Microfilms Order No. DA8727977

Middle atmospheric transient electromagnetic fields generated by lightning-induced charge perturbations are investigated via a simulation of the complete set of Maxwell's equations. A time domain finite element analysis is employed for the simulations. The atmosphere is modeled as a region contained within a right circular cylinder with a height of 80 km and radius of 60 km. All electromagnetic parameters are set equal to their free space value with the exception of the conductivity. Three altitude-varying conductivities, a simple exponential, the Gish model, and a profile based on measured data are used. The simulation's charge perturbations are designed to temporally and spatially approximate the rearrangement of charge following lightning. Previous investigations of this phenomenon have usually assumed a conservative electric field and, as a consequence, constrained the electric field to decay exponentially in time. The present study simulates field behavior that is in good agreement with data. This simulated behavior is not possible if a conservative electric field restriction is enacted. A concatenation of the simulated electric field signatures is included. Dissert. Abstr.

N88-24125 California Univ., Los Angeles.
A THEORETICAL MODEL OF THE WASHOUT OF TRACE GASES BY RAINDROPS IN THE ATMOSPHERE Ph.D. Thesis
Salvador Lopez-Valdivia 1987 341 p
Avail: Univ. Microfilms Order No. DA8728706

Theoretical predictions of pre-existing models for the washout of dichloromethane by falling water drops were verified experimentally. Exploratory calculations were performed that show that pre-existing washout models are inadequate for application to environmental scenarios. A new model was developed for the scavenging of gaseous pollutants by falling raindrops in the subcloud region. This model includes a quantitative assessment of the effects that arise from altitudinal variations of the pressure, the mixing ratio of the scavenged species, the relative humidity, and the temperature. Thus drop evaporation in the scavenging domain is treated. The new model was used to explore the time dependences of the overall scavenging and wet deposition rates, of the vertical pollutant profiles, and of the pH drop spectra, as a function of the environmental conditions, for a variety of SO2 washout scenarios of interest, thereby allowing the influence of the pollutant distribution, rainfall rate and variations in the vertical temperature and relative humidity profiles on drop-size dependent rainwater solute concentrations to be established. Dissert. Abstr.

N88-24005# Meteorological Satellite Center, Tokyo (Japan).
LATITUDINAL AND SEASONAL VARIATION OF THE CLOUD CHARACTERISTIC PARAMETERS AND THEIR EFFECTS ON THE CLOUD CLASSIFICATION
Tadashi Aso, Kazuhiro Oosawa, and Yoshiaki Takeuchi *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 9-20 (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

N88-24010# Meteorological Satellite Center, Tokyo (Japan).
OPEN CELL ASSOCIATED WITH WARM ADVECTION
Kazufumi Suzuki *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 59-69 In JAPANESE; ENGLISH summary (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

N88-24053# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PROCESSING OF HRPT DATA FROM THE NOAA SERIES SATELLITES [PROCESSAMENTO DOS DADOS HRPT DOS SATELITES DA SERIE NOAA]
Carlos Ho Shih Ning, Keiko Tanaka, Maria Roseli Cabral, Yoshihiro Yamazaki, and Yukitaka Nakamura *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 455-463 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24054# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NAVIGATION SYSTEM FROM AVHRR DATA FROM NOAA SERIES SATELLITES [SISTEMA DE NAVEGACAO DOS DADOS AVHRR DOS SATELITES DA SERIE NOAA]
Valder deMatosMedeiros, Keiko Tanaka, and Yoshihiro Yamazaki *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 464-471 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24055# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
COMPARISON OF THE SOLAR RADIATION ESTIMATION METHOD BY SATELLITES [AFERICAO DO METODO DE ESTIMATIVA DA RADIACAO SOLAR POR SATELITES]
Elisabete CariaMoraes and Fausto CarlosdeAlmeida *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1

1986 p 472-478 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24056# Instituto de Cartografia Aeronautica, Rio de Janeiro (Brazil).
A SYSTEM FOR DETERMINATION OF WIND FIELDS USING GEOSTATIONARY METEROLOGICAL SATELLITES [UM SISTEMA PARA A DETERMINACAO DE CAMPOS DE VENTOS UTILIZANDO SATELITES METEOROLOGICOS GEOSTACIONARIOS]
Eni AlvimdeOliveira, Nelson D. A. Mascarenhas, and Alberto W. Setzer *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 479-484 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24057# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DIGITAL PROCESSING OF INFRARED AND VISIBLE IMAGES FROM THE GOES SATELLITE AND ITS INTEGRATION WITH METEOROLOGICAL RADAR DATA [PROCESSAMENTO DIGITAL DE IMAGENS INFRAVERMELHO E VISIVEL DO SATELITE GOES E SUA INTEGRACAO COM DADOS DE RADAR METEOROLOGICO]
Jorge Conrado Conforte, Maria AparecidaSenaubarAlves, Fausto CarlosdeAlmeida, and Oswaldo Massambani (Sao Paulo Univ., Brazil) *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 485-493 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24059# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TIROS OPERATIONAL VERTICAL SOUNDER (TOVS) AND RADIOSONDING IN THE REGION [O TOVS E AS RADIOSONDAGENS NO PAIS]
Paulo Roberto Foster, Yoshihiro Yamazaki, Carlos Ho Shih Ning, and Maria Roseli Cabral *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 501-507 In PORTUGUESE; ENGLISH summary Original language document was announced as N88-20743 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24071# BP Mineracao Ltda., Rio de Janeiro (Brazil).
TORNADO TRACKS IN SOUTHWESTERN BRAZIL, EASTERN PARAGUAY, AND NORTHWESTERN ARGENTINA [RASTROS DE TORNADOS NO SUDOESTE DO BRASIL, LESTE DO PARAGUAI E NORDESTE DA ARGENTINA]
Robert C. Dyer *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 589-603 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24083# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF A FLOOD PERIOD (JUNE, 1984) IN THE SOUTHERN REGION OF LAGUNA DOS PATOS, THROUGH REMOTE SENSING DATA, METEOROLOGICAL AND OCEANOGRAPHIC [AVALICAO DE UM PERIODO DE CHEIA (JUNHO DE 1984) NA REGIAO SUL DA LAGUNA DOS PATOS, ATRAVES DE DADOS DE SENSORIAMENTO REMOTO, METEOROLOGICOS E OCEANOGRAFICOS]
C. Hartmann, E. E. Sano, R. S. Paz, and O. O. Moeller, Jr. *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 685-694 In PORTUGUESE; ENGLISH summary Prepared in cooperation with Fundacao Univ. do Rio Grande (Brazil). (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N88-24126*# Alaska Univ., Fairbanks. Geophysical Inst.
INFLUENCE OF THE YUKON RIVER ON THE BERING SEA Final Report
Kenneson G. Dean and C. Peter McRoy 1988 22 p Original contains color illustrations
(Contract NAS5-28769)
(NASA-CR-182802; NAS 1.26:182802) Avail: NTIS HC A03/MF A01 CSCL 08C

Physical and biological oceanography of the northern Bering Sea including the influence of the Yukon River were studied. Satellite data acquired by the Advanced Very High Resolution Radiometer (AVHRR), the LANDSAT Multispectral Scanner (MSS) and the Thematic Mapper (TM) sensor were used to detect sea surface temperatures and suspended sediments. Shipboard measurements of temperature, salinity and nutrients were acquired through the Inner Shelf Transfer and Recycling (ISHTAR) project and were compared to digitally enhanced and historical satellite images. The satellite data reveal north-flowing, warm water along the Alaskan coast that is highly turbid with complex patterns of surface circulation near the Yukon River delta. To the west near the Soviet Union, cold water, derived from an upwelling, mixes with shelf water and also flows north. The cold and warm water coincide with the Anadyr, Bering Shelf and Alaskan coastal water masses. Generally, warm Alaskan coastal water forms near the coast and extends offshore as the summer progresses. Turbid water discharged by the Yukon River progresses in the same fashion but extends northward across the entrance to Norton Sound, attaining its maximum surface extent in October. The Anadyr water flows northward and around St. Lawrence Island, but its extent is highly variable and depends upon mesoscale pressure fields in the Arctic Ocean and the Bering Sea. Author

N88-24127# Science Applications International Corp., Monterey, Calif.
AN INVESTIGATION OF SOVIET CAPABILITIES IN EXTENDED RANGE ARCTIC ICE FORECASTING Final Report
Dec. 1987 140 p
(Contract N00014-85-C-0763)
(AD-A191082) Avail: NTIS HC A07/MF A01 CSCL 08L

Recent trends in Soviet ice forecasting include: (1) rapid development in the use of satellite infrared, microwave, and side looking radar data relative to ice conditions in the last few years; (2) the continued emphasis on empirical or empirical/dynamic mixed models emphasizing application to regional problems; and (3) an arctic atmospheric circulation pattern change and a concomitant spatial shift of ice conditions within the Alaskan to Siberian sector that were most highly correlated with the ice flux through the Fram Strait. The arctic atmospheric circulation pattern change was identified as a result of the evaluation work done by the author on a Soviet statistical model. A significant shift in emphasis by the Soviets on the forcing of climate trends occurred during the 1970's. This shift marked a break to atmospheric/oceanic cryospheric physical forcing relationships. The Soviets continued to emphasize empirical/statistical modeling throughout the 1970's. GRA

N88-24128# Science Applications International Corp., College Station, Tex.
SEA ICE KINEMATICS: SPACE AND TIME SCALES

James K. Lewis, Maria R. Giuffrida, and Warren W. Denner Jan. 1988 37 p
(Contract N00014-87-C-0173)
(AD-A191162; SAIC-87/1870) Avail: NTIS HC A03/MF A01 CSCL 08L

Ice kinematics are described in terms of the 5 basic modes of motion: divergence (D), vorticity (zeta), deformation rate (T), and ice translation (U). Seasonal time histories of these ice kinematic parameters (IKP) were calculated using position data from drifting buoys in the arctic during May, Aug., and Nov. 1979. Results were used to determine seasonal space and time scales of D, zeta, T, and translation speed variations in the arctic. An e-folding scale is used as a measure of temporal coherency. Spatial variability is defined in terms of the degree of similarity between the magnitudes of a parameter at various locations. Results of seasonal space and time scale analyses indicate that divergence was the most temporally and spatially variable of the IKP for all seasons. Translation speed was the most consistent in space and time. Significant variations in divergence occurred in some areas on the order of 110 km and within approx. 2 hours. In contrast, significant variations in the translation speed occurred in some areas on the order of 705 km and over a period as great as 80 hours. This information is appropriate for setup of numerical simulations of ice motion. GRA

N88-24129# Science Applications International Corp., College Station, Tex.
EXAMPLES OF ICE PACK RIGIDITY AND MOBILITY CHARACTERISTICS DETERMINED FROM ICE MOTION
James K. Lewis, Ronald E. Englebretson, and Warren W. Denner Jan. 1988 19 p
(Contract N00014-87-C-0173)
(AD-A191163; SAIC-87/1869) Avail: NTIS HC A03/MF A01 CSCL 08L

A method has been developed to determine ice pack rigidity and mobility using observed ice motion. With this method, one may determine how solidly the ice pack is frozen in near real-time. Spatial and temporal variations in the freezing and thawing of the ice pack can also be studied. This method was developed to study how well numerical ice modeling techniques were reproducing actual sea ice processes. The ice pack rigidity parameter is now being used to compare observed periods of ice pack thawing and freezing with models from the same regions and times. Various degrees of ice rigidity and mobility were studied using remotely-sensed ice motion data off the north coast of Alaska during 1975 and 1979. Characteristics of the time histories of pack ice speed were used to infer changes in the rigidity of pack ice. Summer-time ice rigidities were detected first in late June 1975 and lasted through September. However, in 1979 considerably higher rigidities were found in August while summer-like rigidities were detected into late November. Analyses of atmospheric pressure distributions suggest that less mechanical breakup occurred in the summer of 1979, resulting in the greater rigidities during August of that year. GRA

N88-24024# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
COMPARISON OF SURFACE CURRENT DETERMINED FROM SATELLITE-TRACKED BUOY WITH SHIPBOARD WIND DATA DURING THE 4TH BRAZILIAN ANTARCTIC EXPEDITION, 10-14 MARCH, 1986
Merritt R. Stevenson, Eduardo M. B. Alonso, Carlos L. DaSilva, Jr., and Reinaldo Solewicz *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SEELPER Plenary Meeting, Volume 1986 1 p (For primary document see PER Plenary Meeting, Volume 1 p 181 (SEE N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24058# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NEAR SURFACE CURRENT DETERMINED FROM INPE'S SATELLITE-TRACKED BUOY, DURING 6-26 NOVEMBER, 1985
Merritt R. Stevenson and Eduardo M. B. Alonso *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 494-500 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

51 LIFE SCIENCES (GENERAL)

N88-24130# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
BOTANY FACILITY PRE-PHASE C/D. CORE PAYLOAD FOR EURECA, VOLUME 2 Final Report
Paris, France ESA 18 Nov. 1986 393 p In ENGLISH and GERMAN Sponsored in cooperation with Microtecnica, Turino, Italy; Sira Institute Ltd., Chislehurst, United Kingdom; and Bell Telephone Mfg. Co., Antwerp, Belgium
(Contract ESA-6415/85-NL-PR)
(BF-RP-ER-015-Vol-2; ESA-CR(P)-2510-Vol-2; ETN-88-91959)
Copyright Avail: NTIS HC A17/MF A01

The Life Support Subsystem (LSS); the impact of control errors on the volume/weight demand of the ventilation and dryer; and the activities performed during the EURECA Botany Facility (BF) predevelopment phase of the LSS are presented. Methods for pollen storage and dispersal were examined. The thermal control (TC) subsystem and the heat transfer at the glass disk as well as the temperature distribution in the fluorescent tube were tested. A suitable configuration for the BF illumination system, magnetic fluid seals for the LSS and TC rotating seals, and a balancing system for the BF centrifuge were investigated. Problems of plant fixation, water supply, plant nutrients, and soil in the BF are treated. The study and distribution of plant nutrients, and the removal of phytotoxins in the BF are outlined. For individual titles, see N88-24131 through N88-24143.

N88-24131# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
LIFE SUPPORT SUBSYSTEM (LSS). CONCEPT FOR THE BOTANY FACILITY **c54**
H. Loeser *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 21 p (For primary document see N88-24130 17-51)
(TN-RB524-107/86) Copyright Avail: NTIS HC A17/MF A01

The design concept of the LSS for the EURECA Botany Facility is described on a functional basis, with a view to systems design drawings and the required inputs for data handling. The LSS is subdived into 3 modules: the Atmosphere Storage And Composition Control module, the Ventilation And Dryer module, and the Soil, Agar And Seed module. The requirements and concept description of each module are given. ESA

N88-24132# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
IMPACT OF CONTROL ERRORS ON THE VOLUME/WEIGHT DEMAND OF THE VENTILATION AND DRYER (VAD) CONCEPT **c54**
H. Loeser and W. P. Foth *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 28 p (For primary document see N88-24130 17-51)
(TN-RB524-006/87) Copyright Avail: NTIS HC A17/MF A01

The soil volume and the water weight required for the VAD-concept based on water reclamation and the VAD-concept centralized water condensation/collection were computed in order to provide inputs for a preliminary component accommodation. After a comparison of the results, the VAD-module based on centralized water condensation/collection, the soil, agar, and aeed module is proposed as baseline solution as the best compromise between technical maturity and weight and volume penalties. ESA

N88-24133# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
SUMMARY OF THE ACTIVITIES PERFORMED DURING THE BOTANY FACILITY (BF) PREDEVELOPMENT PHASE FOR THE LIFE SUPPORT S/S (LSS) **c54**
H. Loeser *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 89 p (For primary document see N88-24130 17-51)
(TB-RB524-002/87) Copyright Avail: NTIS HC A17/MF A01

The results obtained in the predevelopment phase in the different work packages for the LSS are summarized in order to facilitate for the customer comparison between the tasks. The tasks performed and the results obtained in the following work packages are summarized: solution of design problems related to botanical requirements; subsystem design; laboratory model design; model manufacturing; test and verification; design, manufacturing and test of the Atmosphere Storage And Composition Control module for the model; and experiment concept of model payload. ESA

N88-24134# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
EXAMINATION OF METHODS FOR POLLEN STORAGE AND DISPERSAL
K. Loetzerich and H. Loeser *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 19 p (For primary document see N88-24130 17-51)
(TN-RB524-097/86) Copyright Avail: NTIS HC A17/MF A01

Methods to store pollens and to dispose of them when pollination is accomplished were examined. The likely basic requirements which a Pollen Storage And Dispersal Device (PSADD) has to meet were compiled, and features of pollen were identified. The pollination methods are discussed, and two PSADD options are described. The preferred option consists of a storage volume formed by a duct and a cylindrical membrane that is opened electrically when pollination has to be initiated. The air flow of the life support system can carry the pollen away and distribute them in the cuvette. It is recommended to review the proposed concept and to test it in a model cuvette of the laboratory model in order to confirm its feasibility. ESA

N88-24135# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
BOTANY FACILITY. THERMAL CONTROL (TC) SUBSYSTEM TEST REPORT ON EXPERIMENT CONTAINER OF LABORATORY MODEL AND BREADBOARD CENTRIFUGE **c35**
W. Fischer *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 36 p (For primary document see N88-24130 17-51)
(BF-TN-ER-061/86) Copyright Avail: NTIS HC A17/MF A01

The Botany Facility TC (Thermal Control or Thermocouple) subsystem was tested in the environmental laboratory. All data could be generated within the required accuracy and to the required extent. The TC-subsystems of the Laboratory Model and Experiment Container and Centrifuge were successfully tested. ESA

N88-24136# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
BOTANY FACILITY: TEST REPORT ON BREADBOARD TESTS FOR THE DETERMINATION OF THE HEAT TRANSFER AT THE GLASS DISK AND OF THE TEMPERATURE DISTRIBUTION IN THE FLUORESCENT TUBE [BOTANY FACILITY: TESTBERICHT DER BREADBOARD-TESTS ZUR ERMITTLUNG DES WAERMEUBERGANGES AN DER GLASSCHEIBE UND DER TEMPERATURVERTEILUNG AN DER LEUCHTSTOFFROEHRE] **c35**
W. Fischer *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 110 p In GERMAN (For primary document see N88-24130 17-51)
(BF-TN-ER-053) Copyright Avail: NTIS HC A17/MF A01

Botany Facility tests were performed in an environmental laboratory in order to determine the heat transfer at the glass disk of the breadboard model and the temperature distribution in the fluorescent tube under different environmental conditions. The test objects, test facility, instrumentation, environmental conditions, and test procedures are described. The tests were successful since all data needed were obtained with the required accuracy. The extent of the data was substantially increased during the tests, allowing safe predictions. ESA

N88-24137# Sira Inst. Ltd., Chislehurst (England). Research and Development Div.
BOTANY FACILITY: BREADBOARDING RESULTS OF THE ILLUMINATION SYSTEM **c35**
M. A. Cutter *In* MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 15 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP110/MAC003) Copyright Avail: NTIS HC A17/MF A01

Experiments were undertaken to establish a suitable configuration for the EURECA Botany Facility illumination system. The basic requirements for the illumination system are presented. The relationship between photometric and radiometric measurements is discussed. Experimental data aiming at the establishment of a lamp running-in period are discussed. The lamp-to-lamp light output variation was assessed. The results of experiments aiming at the establishment of a suitable cuvette reflector design are treated, including an assessment of the fluorescent lamp reflector design and the back and sidewall reflectors for the cuvettes. The preferred design was analyzed with respect to absolute illuminance and uniformity at the base of the cuvettes. The temporal variation of the cuvette-cuvette light level was assessed. ESA

N88-24138# Sira Inst. Ltd., Chislehurst (England). Research and Development Div.
BOTANY FACILITY: MAGNETIC FLUID SEAL CONSIDERATIONS FOR THE CENTRIFUGE **c37**
M. A. Cutter *In* MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 6 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP110/MAC004) Copyright Avail: NTIS HC A17/MF A01

The implementation of magnetic fluid seals, proposed for the Life Support and Thermal Control rotating seals on the EURECA Botany Facility Centrifuge, was studied. The magnet assemblies, required at each of the inner/outer interfaces of the rotating seal to retain the magnetic fluid, the shaft for the rotating seals, and the magnetic fluids are described. The vibration and shock resistance, the assembly procedure, the compatibility of rubbers with magnetic fluids, the biocompatibility, the launch/landing conditions, and the lifetimes are discussed. ESA

N88-24139# Sira Inst. Ltd., Chislehurst (England). Research and Development Div.
BOTANY FACILITY: CONSIDERATIONS AND ANALYSES OF THE BALANCING SYSTEM PHILOSOPHY PROPOSED FOR THE BF CENTRIFUGE **c29**
P. J. W. Ford *In* MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 39 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP110/PWF001) Copyright Avail: NTIS HC A17/MF A01

The analyses undertaken during the design phase of the balancing system, proposed for the centrifuge on the EURECA Botany Facility, are explained. The nature of the out-of-balance condition was examined using computer model simulations in order to understand the influence of forces and couples generated by rotating systems on the microgravity environment of the structure that supports it (in this case the EURECA platform). The interdependence of static and dynamic out-of-balance forces and couples for ground and orbital conditions were examined. Specific areas of the system such as the effects of gain differences in the

strain gage amplifiers, and the effect of balance mass transfer on the centrifuge rotational inertia, were analyzed. ESA

N88-24140# Sira Inst. Ltd., Chislehurst (England).
BOTANY FACILITY: THE PROBLEMS OF PLANT FIXATION **c29**
In MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 10 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP220/RJS/001) Copyright Avail: NTIS HC A17/MF A01

The problems of specimen fixation are defined and the problems likely to be encountered in performing this process in space are indicated. The fixation process is required to stop plant growth at a specified time and to preserve grass and microscopic structure until the EURECA Botany Facility returns to Earth after a period of up to 9 months. The parts to be preserved are stem, root, fruits, and seeds. The methods of applying fixation are presented. The chemical problems related to the extreme toxicity of some fixatives are discussed. Physical problems such as the good isolation of the cuvette, and the diffusion rate of the fixation through the plant structure are discussed. ESA

N88-24141# Sira Inst. Ltd., Chislehurst (England).
BOTANY FACILITY: PROBLEMS OF WATER SUPPLY, PLANT NUTRIENTS AND SOIL IN THE BOTANY FACILITY
In MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 6 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP220/RJS/003) Copyright Avail: NTIS HC A17/MF A01

The major points to be considered in providing the correct environment for plant roots in the EURECA Botany Facility (BF) are treated. The term soil describes the medium in which the roots propagate. In relation with water supply the principle of water recycling the in cuvettes, the automatic centrifuge balancing system, the water storage problem, the water distribution system, and the seed storage conditions are discussed. The main problems associated with substrates for plant growth are outlined. The problem of maintaining supplies of nutrients to the plant throughout its life under BF conditions is discussed. ESA

N88-24142# Sira Inst. Ltd., Chislehurst (England). Research and Development Div.
SUPPLY AND DISTRIBUTION OF PLANT NUTRIENTS IN THE BOTANY FACILITY
R. J. Simpson *In* MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 9 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP220/RJS/004) Copyright Avail: NTIS HC A17/MF A01

The adequate supply of nutrients and trace elements required for plants grown in the EURECA Botany Facility (BF) to reach maturity and to generate new seeds is discussed. The delivery of soluble nutrients to plant roots at the required concentrations is a key factor in BF experiments. It is desirable that similarity between zero and microgravity samples be maintained in this respect. Nutrient delivery by passive and active means is discussed. Active (pumped) delivery and feedback control is probably best, although the most complex option. The use of nonspecific measurements, such as electrical conductivity for control is probably feasible in the context of BF, but the use of specific chemical sensors is probably not a viable option at present. The use of porous materials as plant substrates and for water storage is discussed. ESA

N88-24143# Sira Inst. Ltd., Chislehurst (England).
EURECA BOTANY FACILITY. TECHNICAL NOTE: REMOVAL OF PHYTOTOXINS **c54**
In MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 2 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP220/RJS/005) Copyright Avail: NTIS HC A17/MF A01

Two methods for the removal of phytotoxins from the atmosphere of the Botany Facility are considered. The only substance produced by plants that is likely to affect them is ethylene. The chemical removal of ethylene requires a reaction in which neither the reagent nor the products are phytotoxic, and which is capable of removing ethylene down to low levels. The most suitable reaction is found to be that with potassium permanganate suported on silica gel. The chemical is simple, but suffers from the resistance to the air flow introduced, thereby increasing the required for power, and from its finite capacity for ethylene removal. The catalytic removal of ethylene by oxidation to carbon dioxide and water has an infinite removal capacity, but requires power and represents an additional thermal load. The catalytic method is preferred. ESA

N88-24144# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
BOTANY FACILITY PRE-PHASE C/D. CORE PAYLOAD FOR EURECA, VOLUME 1 Final Report
Paris, France ESA 29 Apr. 1987 231 p Prepared in cooperation with Microtecnica, Turino, Italy; Sira Institute Ltd., Chislehurst, United Kingdom; and Bell Telephone Mfg. Co., Antwerp, Belgium
(Contract ESA-6415/85-NL-PR)
(BF-RP-ER-015-Vol-1; ESA-CR(P)-2510-Vol-1; ETN-88-91958)
Avail: NTIS HC A11/MF A01

The EURECA botany facility design definition and interfaces, and testing of the centrifuge and a laboratory model are described. The facility is a multiuser life sciences facility intended to support specific botanical investigations during the lower orbital missions of EURECA. The experiments proposed for the first mission are concerned with plants, fungi, and insects and these factors drive the design of the facility presented. The major aim of the scientific experimentation is to investigate the behavior of the biological samples under microgravity conditions and to compare it with that shown by similar samples accommodated on the on-board 1 g reference centrifuge. Near terrestial conditions are simulated within the facility with respect to sample atmospheric conditions, pressure, and humidity. The facility also provides samples with near terrestial condition with respect to water and nutrient supplies, and a suitable diurnal illumination. ESA

N88-24145*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SPACE STATION HUMAN FACTORS RESEARCH REVIEW. VOLUME 1: EVA RESEARCH AND DEVELOPMENT
Marc M. Cohen, ed. and H. C. Vykukal, ed. Apr. 1988 136 p Workshop held at Moffett Field, Calif., 3-6 Dec. 1985
(NASA-CP-2426-Vol-1; A-87163-Vol-1; NAS 1.55:2426-Vol-1)
Avail: NTIS HC A07/MF A01 CSCL 06B

An overview is presented of extravehicular activity (EVA) research and development activities at Ames. The majority of the program was devoted to presentations by the three contractors working in parallel on the EVA System Phase A Study, focusing on Implications for Man-Systems Design. Overhead visuals are included for a mission results summary, space station EVA requirements and interface accommodations summary, human productivity study cross-task coordination, and advanced EVAS Phase A study implications for man-systems design. Articles are also included on subsea approach to work systems development and advanced EVA system design requirements. For individual titles, see N88-24146 through N88-24147.

N88-24146*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SUBSEA APPROACH TO WORK SYSTEMS DEVELOPMENT
M. L. Gernhardt, F. R. Frisbie, and C. E. Brown *In its* Space Station Human Factors Research Review. Volume 1: EVA Research and Development Apr. 1988 p 69-84 Sponsored by Oceaneering International (For primary document see N88-24145 17-51)
Avail: NTIS HC A07/MF A01 CSCL 05H

Self-contained undersea working environments with applications

to space station EVA environments are discussed. Physiological limitations include decompression, inert gas narcosis, high-pressure nervous system, gas toxicity, and thermal limitations. Work task requirements include drilling support, construction, inspection, and repair. Work systems include hyperbaric diving, atmospheric work systems, telo-operated work systems, and hybrid systems. Each type of work system is outlined in terms of work capabilities, special interface requirements, and limitations. Various operational philosophies are discussed. The evolution of work systems in the subsea industry has been the result of direct operational experience in a competitive market. J.P.B.

N88-24147*# McDonnell-Douglas Astronautics Co., Houston, Tex.

ADVANCED EVA SYSTEM DESIGN REQUIREMENTS STUDY **c54**

T. G. Woods *In* NASA, Ames Research Center, Space Station Human Factors Research Review. Volume 1: EVA Research and Development Apr. 1988 p 85-130 (For primary document see N88-24145 17-51)

Avail: NTIS HC A07/MF A01 CSCL 05H

The results are presented of a study to identify specific criteria regarding space station extravehicular activity system (EVAS) hardware requirements. Key EVA design issues include maintainability, technology readiness, LSS volume vs. EVA time available, suit pressure/cabin pressure relationship and productivity effects, crew autonomy, integration of EVA as a program resource, and standardization of task interfaces. A variety of DOD EVA systems issues were taken into consideration. Recommendations include: (1) crew limitations, not hardware limitations; (2) capability to perform all of 15 generic missions; (3) 90 days on-orbit maintainability with 50 percent duty cycle as minimum; and (4) use by payload sponsors of JSC document 10615A plus a Generic Tool Kit and Specialized Tool Kit description. EVA baseline design requirements and criteria, including requirements of various subsystems, are outlined. Space station/EVA system interface requirements and EVA accommodations are discussed in the areas of atmosphere composition and pressure, communications, data management, logistics, safe haven, SS exterior and interior requirements, and SS airlock. J.P.B.

N88-24148*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SPACE STATION HUMAN FACTORS RESEARCH REVIEW. VOLUME 4: INHOUSE ADVANCED DEVELOPMENT AND RESEARCH

Trieve Tanner, ed., Yvonne A. Clearwater, ed., and Marc M. Cohen, ed. May 1988 135 p Workshop held at Moffett Field, Calif., 3-6 Dec. 1985

(NASA-CP-2426-Vol-4; A-87247-Vol-4; NAS 1.55:2426-Vol-4)

Avail: NTIS HC A07/MF A01 CSCL 06B

A variety of human factors studies related to space station design are presented. Subjects include proximity operations and window design, spatial perceptual issues regarding displays, image management, workload research, spatial cognition, virtual interface, fault diagnosis in orbital refueling, and error tolerance and procedure aids. For individual titles, see N88-24149 through N88-24154.

N88-24149*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SPACE STATION PROXIMITY OPERATIONS AND WINDOW DESIGN **c18**

Richard F. Haines *In its* Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 1-18 (For primary document see N88-24148 17-51)

Avail: NTIS HC A07/MF A01 CSCL 22B

On-orbit proximity operations (PROX-OPS) consist of all extravehicular activity (EVA) within 1 km of the space station. Because of the potentially large variety of PROX-OPS, very careful planning for space station windows is called for and must consider a great many human factors. The following topics are discussed: (1) basic window design philosophy and assumptions; (2) the concept of the local horizontal - local vertical on-orbit; (3) window linear dimensions; (4) selected anthropomorphic considerations; (5) displays and controls relative to windows; and (6) full window assembly replacement. Author

N88-24150*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

IMAGE MANAGEMENT RESEARCH **c54**

Andrew B. Watson *In its* Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 23-28 (For primary document see N88-24148 17-51)

Avail: NTIS HC A07/MF A01 CSCL 05H

Two types of research issues are involved in image management systems with space station applications: image processing research and image perception research. The image processing issues are the traditional ones of digitizing, coding, compressing, storing, analyzing, and displaying, but with a new emphasis on the constraints imposed by the human perceiver. Two image coding algorithms have been developed that may increase the efficiency of image management systems (IMS). Image perception research involves a study of the theoretical and practical aspects of visual perception of electronically displayed images. Issues include how rapidly a user can search through a library of images, how to make this search more efficient, and how to present images in terms of resolution and split screens. Other issues include optimal interface to an IMS and how to code images in a way that is optimal for the human perceiver. A test-bed within which such issues can be addressed has been designed. J.P.B.

N88-24151*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NASA-AMES WORKLOAD RESEARCH PROGRAM **c54**

Sandra Hart *In its* Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 29-76 (For primary document see N88-24148 17-51)

Avail: NTIS HC A07/MF A01 CSCL 05H

Research has been underway for several years to develop valid and reliable measures and predictors of workload as a function of operator state, task requirements, and system resources. Although the initial focus of this research was on aeronautics, the underlying principles and methodologies are equally applicable to space, and provide a set of tools that NASA and its contractors can use to evaluate design alternatives from the perspective of the astronauts. Objectives and approach of the research program are described, as well as the resources used in conducting research and the conceptual framework around which the program evolved. Next, standardized tasks are described, in addition to predictive models and assessment techniques and their application to the space program. Finally, some of the operational applications of these tasks and measures are reviewed. Author

N88-24152*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SPATIAL COGNITION **c53**

Mary Kister Kaiser and Roger Remington *In its* Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 77-83 (For primary document see N88-24148 17-51)

Avail: NTIS HC A07/MF A01 CSCL 05I

Spatial cognition is the ability to reason about geometric relationships in the real (or a metaphorical) world based on one or more internal representations of those relationships. The study of spatial cognition is concerned with the representation of spatial knowledge, and our ability to manipulate these representations to solve spatial problems. Spatial cognition is utilized most critically when direct perceptual cues are absent or impoverished. Examples are provided of how human spatial cognitive abilities impact on three areas of space station operator performance: orientation, path planning, and data base management. A videotape provides demonstrations of relevant phenomena (e.g., the importance of

orientation for recognition of complex, configural forms). The presentation is represented by abstract and overhead visuals only. Author

N88-24153*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VIRTUAL INTERFACE ENVIRONMENT c54
Scott S. Fisher *In its* Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 85-87 Previously announced in IAA as A87-31494 (For primary document see N88-24148 17-51)
Avail: NTIS HC A07/MF A01 CSCL 05H

A head-mounted, wide-angle, stereoscopic display system controlled by operator position, voice and gesture is under development for use as a multipurpose interface environment. Initial applications of the system are in telerobotics, data-management and human factors research. System configuration and research directions are described. Author

N88-24154*# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
FAULT DIAGNOSIS IN ORBITAL REFUELING OPERATIONS c18
Guy A. Boy *In* NASA, Ames Research Center, Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 89-112 (For primary document see N88-24148 17-51)
Avail: NTIS HC A07/MF A01 CSCL 22B

Usually, operation manuals are provided for helping astronauts during space operations. These manuals include normal and malfunction procedures. Transferring operation manual knowledge into a computerized form is not a trivial task. This knowledge is generally written by designers or operation engineers and is often quite different from the user logic. The latter is usually a compiled version of the former. Experiments are in progress to assess the user logic. HORSES (Human - Orbital Refueling System - Expert System) is an attempt to include both of these logics in the same tool. It is designed to assist astronauts during monitoring and diagnosis tasks. Basically, HORSES includes a situation recognition level coupled to an analytical diagnoser, and a meta-level working on both of the previous levels. HORSES is a good tool for modeling task models and is also more broadly useful for knowledge design. The presentation is represented by abstract and overhead visuals only. Author

N88-24155* Lockheed Engineering and Management Services Co., Inc., Washington, D.C.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 17
Lydia Razran Hooke, ed., Ronald Teeter, ed., Victoria Garshnek, ed., and Joseph Rowe, ed. (Library of Congress, Washington D.C.) Washington NASA Jun. 1988 126 p
(Contract NASw-4292)
(NASA-CR-3922(20); NAS 1.26:3922(20)) Avail: Issuing Activity CSCL 06C

This is the seventeenth issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 62 papers published in Russian language periodicals or presented at conferences and of 3 new Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. The abstracts included in this issue have been identified as relevant to 33 areas of space biology and medicine. These areas are: adaptation, biological rhythms, biospherics, body fluids, botany, cardiovascular and respiratory systems, cytology, cosmonaut training, developmental biology, endocrinology, enzymology, equipment and instrumentation, exobiology, gastrointestinal system, genetics, habitability and environmental effects, hematology, human performance, immunology, life support systems, man-machine systems, mathematical modeling, metabolism, microbiology, musculoskeletal system, neurophysiology, nutrition, operational medicine, perception, personnel selection, psychology, radiobiology, and reproductive biology. Author

N88-24156*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
SOIL EROSION AND CAUSATIVE FACTORS AT VANDENBERG AIR FORCE BASE, CALIFORNIA
Joel B. Butterworth (Bionetics Corp., Cocoa Beach, Fla.) Mar. 1988 51 p
(Contract NAS10-10285)
(NASA-TM-100981; NAS 1.15:100981) Avail: NTIS HC A04/MF A01 CSCL 13B

Areas of significant soil erosion and unvegetated road cuts were identified and mapped for Vandenberg Air Force Base. One hundred forty-two eroded areas (most greater than 1.2 ha) and 51 road cuts were identified from recent color infrared aerial photography and ground truthed to determine the severity and causes of erosion. Comparison of the present eroded condition of soils (as shown in the 1986 photography) with that in historical aerial photography indicates that most erosion on the base took place prior to 1928. However, at several sites accelerated rates of erosion and sedimentation may be occurring as soils and parent materials are eroded vertically. The most conspicuous erosion is in the northern part of the base, where severe gully, sheet, and mass movement erosion have occurred in soils and in various sedimentary rocks. Past cultivation practices, compounded by highly erodible soils prone to subsurface piping, are probably the main causes. Improper range management practices following cultivation may have also increased runoff and erosion. Aerial photography from 1986 shows that no appreciable headward erosion or gully sidewall collapse have occurred in this area since 1928. Author

N88-24157*# Maryland Univ., Baltimore. Dept. of Neurology.
EVALUATION OF THE ENDOGENOUS GLUCOCORTICOID HYPOTHESIS OF DENERVATION ATROPHY
Masaaki Konagaya, Yoko Konagaya, and Stephen R. Max [1988] 13 p
(Grant NAG2-100)
(NASA-CR-182848; NAS 1.26:182848; Rept-191/86) Avail: NTIS HC A03/MF A01 CSCL 06B

The effects are studied of the oral administration of RU38486, a potent selective glucocorticoid antagonist, on muscle weight, non-collagen protein content, and selected enzyme activities (choline acetyltransferase, glucose 6-phosphate dehydrogenase, and glutamine synthetase) following denervation of rat skeletal muscle. Neither decreases in muscle weight, protein content, and choline acetyltransferase activity, nor increases in the activities of glucose 6-phosphate dehydrogernase and glutamine synthetase were affected by RU38486. These data do not support the hypothesis that denervation atrophy results from enhanced sensitivity of muscle to endogenous glucocorticoids. Author

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N88-24158 New South Wales Univ., Sydney (Australia). School of Medicine.
ACTIVATION, STRENGTH AND ENDURANCE OF HUMAN RESPIRATORY AND LIMB MUSCLES Ph.D. Thesis Abstract Only
D. K. McKenzie 1987 270 p
Avail: Issuing Activity

The aspects of muscle function is reviewed with emphasis on factors which may limit force generation during the types of muscular effort studied in the experimental chapters. The use of a test which enables direct comparison of endurance properties in human respiratory and limb muscles is reported. The use of phrenic nerve stimulation to investigate the function of the phrenic nerve and diaphragm, and to document the potential sources of error in recordings of the electromyographic activity (EMG) of the diaphragm is described. Phrenic nerve stimulation and recordings of EMG are used to study voluntary activation of the phrenic motoneurone pool during maximal voluntary contractions of the

diaphragm and during diaphragmatic fatigue. The influence of changes in muscle length on endurance is examined. The capacity of respiratory muscles to adapt to physiological loading is suggested in a study of asthmatic and control subjects. The relative proportions and sizes of fiber types in three human inspiratory muscles and a control limb muscle are reported. Some of the implications of this study are examined. Author

N88-24159 New South Wales Univ., Sydney (Australia).
DESIGN CONSIDERATIONS FOR THE DEVELOPMENT OF AN IMPLANTABLE SENSOR FOR THE CONTINUOUS MEASUREMENT OF GLUCOSE IN THE DIABETIC PATIENT
M.S. Thesis Abstract Only
Michael David Hallett 28 Sep. 1987 169 p
Avail: Issuing Activity

The basic design of the sensor incorporates a small column of immobilized glucose oxidase (GOD) through which a buffered carrier stream is passed. The device is designed for peritoneal implantation. Initial work tested the feasibility of such a design for the quantitative analysis of glucose using spectrophotometric analysis of the produced hydrogen peroxide. Subsequently, efforts were concentrated on the development of a model device involving the design and construction of perspex hardware and associated drift free electronic circuitry for use with oxygen sensors. In addition, methods for improvement in long term enzymatic stability were formulated and tested in a series of batch stabilization studies using two types of carbohydrate gel. A number of additives were also tested, including flavin adenine dinucleotide (FAD) and FeCl3. However, results indicated that enzyme immobilization and GA crosslinking were the most significant factors in reducing enzyme inactivation with the addition of FAD and FeCl3 showing little or no effect. Bacteriological contamination was highly significant in enzyme activity decay as was high pH. Author

N88-24160 New South Wales Univ., Sydney (Australia). Centre for Biomedical Engineering.
MATHEMATICAL MODELLING OF THE HEAT AND WATER VAPOUR TRANSPORT IN THE HUMAN RESPIRATORY TRACT
M.S. Thesis Abstract Only
Evangelia Daviskas 1987 182 p
Avail: Issuing Activity

To study the heat and water vapor transport in the human respiratory tract (putatively associated with asthma) while conditioning the inspired air, it is necessary to obtain estimates of intraairway temperatures and water contents. Because these cannot be routinely obtained by direct measurements, a time-dependent mathematical model was developed that could predict them. The wall temperatures were modelled iteratively to give estimates of temperature gradients. The predicted intraairway temperatures at five locations for inspired temperature 26.7 C, inspired water 8.8 mg/L and ventilation 15 to 100 L/min, reproduced experimental data. The model predicted air temperatre and water vapor concentrations at mouth, total heat and water loss per breath that were in good agreement with experimental data if water vapor concentration at the wall was unsaturated from mouth to larynx. The model predicted that conditioning of inspired room air involves not only the extrathoracic airways but the intrathoracic airways, the number of airways being involved depending on the ventilation. The airstream temperature and water vapor concentration equilibrate with the wall temperature and water vapor concentration before the core temperature is reached. It was also predicted that the overall heat and water loss along the respiratory tract during a respiratory cycle is not continuous as some airways gain heat and water. Author

N88-24161* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 311)
Jun. 1988 82 p
(NASA-SP-7011(311); NAS 1.21:7011(311)) Avail: NTIS HC A05 CSCL 06E

This bibliography lists 240 reports, articles, and other documents introduced into the NASA scientific and technical information system in May, 1988. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N88-24152*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SPATIAL COGNITION
Mary Kister Kaiser and Roger Remington *In its* Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 77-83 (For primary document see N88-24148 17-51)
Avail: NTIS HC A07/MF A01 CSCL 05I

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N88-24162*# Martin Marietta Aerospace, Denver, Colo.
TELEOPERATOR HUMAN FACTORS STUDY Final Report
May 1986 68 p
(Contract NAS8-35184)
(NASA-CR-178930; NAS 1.26:178930; MCR-86-542) Avail: NTIS HC A04/MF A01 CSCL 05H

An investigation of the spectrum of space teleoperation activities likely in the 1985 to 1995 decade focused on the resolution of critical human engineering issues and characterization of the technology effect on performance of remote human operators. The study began with the identification and documentation of a set of representative reference teleoperator tasks. For each task, technology, development, and design options, issues, and alternatives that bear on human operator performance were defined and categorized. A literature survey identified existing studies of man/machine issues. For each teleoperations category, an assessment was made of the state of knowledge on a scale from adequate to void. The tests, experiments, and analyses necessary to provide the missing elements of knowledge were then defined. A limited set of tests were actually performed, including operator selection, baseline task definition, control mode study, lighting study, camera study, and preliminary time delay study. J.P.B.

N88-24163* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RECONFIGURABLE WORK STATION FOR A VIDEO DISPLAY UNIT AND KEYBOARD Patent
Nicholas L. Shields, inventor (to NASA), Fred D. Roe, Jr., inventor (to NASA), Mary F. Fagg, inventor (to NASA), and David E. Henderson, inventor (to NASA) (Essex Corp., Huntsville, Ala.) 16 Feb. 1988 9 p Filed 5 Dec. 1985 Supersedes N86-22114 (24 - 12, p 1995)
(NASA-Case-MFS-26009-1-SB; US-Patent-4,725,106; US-Patent-Appl-SN-805011; US-Patent-Class-312-208; US-Patent-Class-108-3; US-Patent-Class-108-7; US-Patent-Class-312-7.2; US-Patent-Class-312-196; US-Patent-Class-312-300) Avail: US Patent and Trademark Office CSCL 05H

A reconfigurable workstation is described having video, keyboard, and hand operated motion controller capabilities. The workstation includes main side panels between which a primary work panel is pivotally carried in a manner in which the primary work panel may be adjusted and set in a negatively declined or positively inclined position for proper forearm support when

operating hand controllers. A keyboard table supports a keyboard in such a manner that the keyboard is set in a positively inclined position with respect to the negatively declined work panel. Various adjustable devices are provided for adjusting the relative declinations and inclinations of the work panels, tables, and visual display panels.

Official Gazette of the U.S. Patent and Trademark Office

N88-24131# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
LIFE SUPPORT SUBSYSTEM (LSS). CONCEPT FOR THE BOTANY FACILITY
H. Loeser *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 21 p (For primary document see N88-24130 17-51)
(TN-RB524-107/86) Copyright Avail: NTIS HC A17/MF A01

N88-24132# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
IMPACT OF CONTROL ERRORS ON THE VOLUME/WEIGHT DEMAND OF THE VENTILATION AND DRYER (VAD) CONCEPT
H. Loeser and W. P. Foth *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 28 p (For primary document see N88-24130 17-51)
(TN-RB524-006/87) Copyright Avail: NTIS HC A17/MF A01

N88-24133# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
SUMMARY OF THE ACTIVITIES PERFORMED DURING THE BOTANY FACILITY (BF) PREDEVELOPMENT PHASE FOR THE LIFE SUPPORT S/S (LSS)
H. Loeser *In its* Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 89 p (For primary document see N88-24130 17-51)
(TB-RB524-002/87) Copyright Avail: NTIS HC A17/MF A01

N88-24143# Sira Inst. Ltd., Chislehurst (England).
EURECA BOTANY FACILITY. TECHNICAL NOTE: REMOVAL OF PHYTOTOXINS
In MBB GmbH, Botany Facility Pre-Phase C/D Core Payload for EURECA, Volume 2 18 Nov. 1986 2 p (For primary document see N88-24130 17-51)
(Sira-A/7373/WP220/RJS/005) Copyright Avail: NTIS HC A17/MF A01

N88-24147*# McDonnell-Douglas Astronautics Co., Houston, Tex.
ADVANCED EVA SYSTEM DESIGN REQUIREMENTS STUDY
T. G. Woods *In* NASA, Ames Research Center, Space Station Human Factors Research Review. Volume 1: EVA Research and Development Apr. 1988 p 85-130 (For primary document see N88-24145 17-51)
Avail: NTIS HC A07/MF A01 CSCL 05H

N88-24150*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IMAGE MANAGEMENT RESEARCH
Andrew B. Watson *In its* Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 23-28 (For primary document see N88-24148 17-51)
Avail: NTIS HC A07/MF A01 CSCL 05H

N88-24151*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA-AMES WORKLOAD RESEARCH PROGRAM
Sandra Hart *In its* Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 29-76 (For primary document see N88-24148 17-51)
Avail: NTIS HC A07/MF A01 CSCL 05H

N88-24153*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VIRTUAL INTERFACE ENVIRONMENT
Scott S. Fisher *In its* Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research May 1988 p 85-87 Previously announced in IAA as A87-31494 (For primary document see N88-24148 17-51)
Avail: NTIS HC A07/MF A01 CSCL 05H

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N88-24164*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ESTIMATION OF TIME- AND STATE-DEPENDENT DELAYS AND OTHER PARAMETERS IN FUNCTIONAL DIFFERENTIAL EQUATIONS Final Report
K. A. Murphy Apr. 1988 53 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181663; ICASE-88-25; NAS 1.26:181663) Avail: NTIS HC A04/MF A01 CSCL 12A

A parameter estimation algorithm is developed which can be used to estimate unknown time- or state-dependent delays and other parameters (e.g., initial condition) appearing within a nonlinear nonautonomous functional differential equation. The original infinite dimensional differential equation is approximated using linear splines, which are allowed to move with the variable delay. The variable delays are approximated using linear splines as well. The approximation scheme produces a system of ordinary differential equations with nice computational properties. The unknown parameters are estimated within the approximating systems by minimizing a least-squares fit-to-data criterion. Convergence theorems are proved for time-dependent delays and state-dependent delays within two classes, which say essentially that fitting the data by using approximations will, in the limit, provide a fit to the data using the original system. Numerical test examples are presented which illustrate the method for all types of delay.

Author

N88-24165*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MINIMAL PARAMETER SOLUTION OF THE ORTHOGONAL MATRIX DIFFERENTIAL EQUATION
Itzhack Y. Bar-Itzhack and F. Landis Markley Jun. 1988 30 p
(NASA-TM-4043; Rept-88B0106; NAS 1.15:4043) Avail: NTIS HC A03/MF A01 CSCL 12A

As demonstrated in this work, all orthogonal matrices solve a first order differential equation. The straightforward solution of this equation requires n sup 2 integrations to obtain the element of the nth order matrix. There are, however, only n(n-1)/2 independent parameters which determine an orthogonal matrix. The questions of choosing them, finding their differential equation and expressing the orthogonal matrix in terms of these parameters are considered. Several possibilities which are based on attitude determination in three dimensions are examined. It is shown that not all 3-D methods have useful extensions to higher dimensions. It is also shown why the rate of change of the matrix elements, which are the elements of the angular rate vector in 3-D, are the elements of a tensor of the second rank (dyadic) in spaces other than three

dimensional. It is proven that the 3-D Gibbs vector (or Cayley Parameters) are extendable to other dimensions. An algorithm is developed employing the resulting parameters, which are termed Extended Rodrigues Parameters, and numerical results are presented of the application of the algorithm to a fourth order matrix. Author

N88-24166*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
[ACTIVITIES OF THE INSTITUTE FOR COMPUTER APPLICATIONS IN SCIENCE AND ENGINEERING (ICASE)] Final Semiannual Report, 2 Oct. 1987 - 31 Mar. 1988
May 1988 48 p
(Contract NAS1-18107)
(NASA-CR-181666; NAS 1.26:181666) Avail: NTIS HC A03/MF A01 CSCL 12A

This report summarizes research conducted at the Institute for Computer Applications Science and Engineering in applied mathematics, numerical analysis, and computer science during the period October 2, 1987 through March 31, 1988. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N88-24167# Royal Signals and Radar Establishment, Malvern (England).
PROTECTION AND SECURITY MECHANISMS IN THE SMITE CAPABILITY COMPUTER
S. R. Wiseman Jan. 1988 16 p
(RSRE-Memo-4117; BR104990; ETN-88-92520) Copyright Avail: NTIS HC A03/MF A01

Microcoded hardware was used to provide capability protection in the main memory of a SMITE computer. Possession of a capability for an object entitles the holder to access it, while it is impossible to access it without a capability. The objects in memory are typed, so each type of object is accessed in different ways. In particular procedures and keyed blocks are offered as mechanisms for information hiding and for creating user defined abstract types. These primitive protection mechanisms allow software to be written to provide flexible security mechanisms. The fine granularity of protection allows the different concerns of security to be split up, allowing correctness to be established more easily, without loss of performance. ESA

N88-24168*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPECIFICATION FOR IBM/IBM COMPATIBLE 3480 TAPE CARTRIDGE
Jimmy L. Perry May 1988 42 p
(NASA-TM-100702; Rept-88B0181; NAS 1.15:100702) Avail: NTIS HC A03/MF A01 CSCL 09B

This document establishes the same kinds of standards and controls that are currently in use for the procurement on new analog and digital magnetic tapes. The Magnetic Tape Certification Facility (MTCF) currently maintains a Quality Products List (QPL) for all new analog and digital magnetic tapes purchased by NASA-GSFC. Extensive tests are conducted in the MTCF on an annual basis to determine the manufacturer's tape types to be added to or deleted from the current QPL. The MTCF currently maintains two specifications for magnetic tapes: NASA TM-79724 is used for the QPL and acceptance testing of new analog tapes; and NASA TM-80599 is used for the QPL and acceptance testing of new digital tapes. This specification will be used for the QPL and acceptance testing of new 3480 cartridges. The magnetic tapes used by GSFC, LaRC, ARC/Dryden, WFF, and the Network Tracking Stations are covered by the NASA-GSFC specifications. The 3480 cartridge was introduced approximately 3.5 years ago and is becoming an increasingly attractive alternative to digital magnetic tapes. Many users have already converted to the 3480 system and have more tape drives on order. Author

N88-24169* National Aeronautics and Space Administration. Pasadena Office, Calif.
REAL TIME PIPELINED SYSTEM FOR FORMING THE SUM OF PRODUCTS IN THE PROCESSING OF VIDEO DATA Patent
Brian Wilcox, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 7 Jun. 1988 8 p Filed 31 Dec. 1985 Supersedes N86-24225 (24 - 14, p 2339)
(NASA-Case-NPO-16462-1-CU; US-Patent-4,750,144; US-Patent-Appl-SN-815106; US-Patent-Class-364-728; US-Patent-Class-364-757; US-Patent-Class-382-42) Avail: US Patent and Trademark Office CSCL 09B

A 3-by-3 convolver utilizes 9 binary arithmetic units connected in cascade for multiplying 12-bit binary pixel values P sub i which are positive or two's complement binary numbers by 5-bit magnitide (plus sign) weights W sub i which may be positive or negative. The weights are stored in registers including the sign bits. For a negative weight, the one's complement of the pixel value to be multiplied is formed at each unit by a bank of 17 exclusive or gates G sub i under control of the sign of the corresponding weight W sub i, and a correction is made by adding the sum of the absolute values of all the negative weights for each 3-by-3 kernel. Since this correction value remains constant as long as the weights are constant, it can be precomputed and stored in a register as a value to be added to the product PW of the first arithmetic unit.

Official Gazette of the U.S. Patent and Trademark Office

N88-24037# Canada Centre for Remote Sensing, Ottawa (Ontario).
PRACTICAL IMAGE ANALYSIS USING PERSONAL COMPUTERS: THE CANADIAN EXPERIENCE Abstract Only
Bill Bruce and John K. Hornsby (INTERA Technologies Ltd., Ottawa, Ontario) *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 333-334 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N88-24170# Range Commanders Council, White Sands Missile Range, N. Mex. Inter-range Inst. Ion Group.
PARALLEL BINARY AND PARALLEL CODED DECIMAL TIME CODE FORMATS
Aug. 1987 63 p Supersedes IRIG-STANDARD-205-77 (AD-A190126; IRIG-STANDARD-205-87; IRIG-STANDARD-205-77) Avail: NTIS HC A04/MF A01 CSCL 14B

The need for time-of-year information with millisecond, microsecond and nanosecond resolution by data handling and instrumentation timing systems makes the use of parallel time codes highly desirable, providing as they do ground rules for maximum compatability between present and future time generating equipment and the user interface (spaceborne and ground systems). All timing equipment for new installations where parallel time is required shall follow this standard. The changeover to the new standard parallel time codes can be made over a period of years as equipment is replaced or as new equipment is installed to meet timing requirements. The designations or nomenclatures for the codes in this standard were selected so as to minimize the impact on existing documentation and to conform to what has become standard notation. This standard should be adhered to

even though use of the parallel time codes may be limited initially to the selection of one code because of a lack of equipment to generate the complete code. GRA

N88-24171# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
A SOFTWARE DESIGN TOOL FOR THE ANALYSIS OF ROBOT DYNAMICS PROPERTIES
R. J. P. Groothuizen, J. I. vandenBerg, and W. vanLeeuwen (Fokker B.V., Amsterdam, Netherlands) 3 Nov. 1986 21 p Presented at the CAPE Nederland'87 Congress on Computer Applications in Production and Engineering, Amsterdam, Netherlands, 17-19 Mar. 1987
(Contract NIVR-427-02305N)
(NLR-MP-86064-4; B8733101; ETN-88-92224) Avail: NTIS HC A03/MF A01

The software tool ROBDYN for analysis of the dynamics properties of a robot is described. Main constituents are a dynamics algorithm and a facility for the pre- and postprocessing of data. The tool enables a detailed analysis of dynamics and control aspects and it improves the path generation procedure. ESA

N88-24172*# General Electric Co., Philadelphia, Pa. Astro Space Div.
THE MULTI-DISCIPLINARY DESIGN STUDY: A LIFE CYCLE COST ALGORITHM Final Contractor Report
R. R. Harding and F. J. Pichi Washington NASA Jun. 1988 30 p
(Contract NAS1-18032)
(NASA-CR-4156; NAS 1.26:4156) Avail: NTIS HC A03/MF A01 CSCL 09B

The approach and results of a Life Cycle Cost (LCC) analysis of the Space Station Solar Dynamic Power Subsystem (SDPS) including gimbal pointing and power output performance are documented. The Multi-Discipline Design Tool (MDDT) computer program developed during the 1986 study has been modified to include the design, performance, and cost algorithms for the SDPS as described. As with the Space Station structural and control subsystems, the LCC of the SDPS can be computed within the MDDT program as a function of the engineering design variables. Two simple examples of MDDT's capability to evaluate cost sensitivity and design based on LCC are included. MDDT was designed to accept NASA's IMAT computer program data as input so that IMAT's detailed structural and controls design capability can be assessed with expected system LCC as computed by MDDT. No changes to IMAT were required. Detailed knowledge of IMAT is not required to perform the LCC analyses as the interface with IMAT is noninteractive. Author

N88-24173# Yale Univ., New Haven, Conn. Dept. of Computer Science.
ON THE EFFICIENT IMPLEMENTATION OF THE FAST MULTIPOLE ALGORITHM
L. Greengard and V. Rokhlin Feb. 1988 20 p
(Contract N00014-86-K-0310)
(AD-A191167; YALEU/DCS/RR-602) Avail: NTIS HC A03/MF A01 CSCL 12A

The Fast Multipole Method (FMM) is a recently developed algorithm for the evaluation of potential fields in particle systems. In order to evaluate the fields induced by a set of N charges (or masses) on each other, the FMM requires order O(N) work rather than the O(N squared) work required by the direct evaluation of pairwise interactions. The constant of proportionality for the method depends on the cost of applying a translation operator to a multiple or Taylor expansion. In existing implementations, this is O(p squared) in two dimensions and O(p to the 4th power) in three, where p is the degree of the expansion. In this paper we describe a procedure permitting translation operators to be applied to p to the 4th power degree expansions for a cost proportional to p log p in two dimensions, and p squared log p in three. The incorporation of this technique into the FMM scheme speeds up the execution of two-dimensional single precision codes by a factor of two or three, and the execution of three-dimensional codes by roughly a factor of eight. GRA

N88-24174# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Computer Science.
A TIMING EVALUATOR FOR C PROGRAMS GENERATED BY THE MODEL SYSTEM
Mahesh Srinivasan and Boleslaw Szymanski Dec. 1987 117 p
(Contract N00014-86-K-0442)
(AD-A191204; RPI-TR-87-29) Avail: NTIS HC A06/MF A01 CSCL 12E

The MODEL system was developed to address the problems involved in the development and maintenance of real time software for embedded computer systems. The primary goal of the MODEL system is to ease the task of developing and maintaining real time software by using a nonprocedural language approach. The secondary goal is to provide automated support to assist programmers in meeting the time constraints imposed by real time software systems. A real time software system can be defined as one which controls an environment by receiving data, processing it and taking action or returning results quickly enough to affect the functioning of the environment at that time. Real time applications are usually connected to embedded computer systems where software controls the operation of a host system such as an aircraft, ship, or factory. Examples of such applications are flight control systems, radar tracking systems, industrial process control systems, etc. GRA

N88-24175# California Univ., Berkeley. Center for Pure and Applied Mathematics.
SCIENTIFIC COMPUTING ENVIRONMENTS Final Report, 15 Aug. 1986 - 14 Aug. 1987
W. Kahan Aug. 1987 3 p
(Grant AF-AFOSR-0158-84)
(AD-A191239; AFOSR-87-1767TR) Avail: NTIS HC A02/MF A01 CSCL 12E

The author pursued research to provide improved subroutines for common arithmetic functions for scientific computations. He produced an algorithm for the accurate implementation of rational arithmetic operations without resorting to multi-precision arithmetic. This was described in a paper entitled Rational arithmetic in floating point. He has also made a careful study of how to make branch cuts in the complex plane so as to allow evaluation of the elementary functions without any anomalies. This was presented in a talk at the conference on State-of-the-Art in Numerical Analysis held in Birmingham, England, April 14 to 18, 1986. GRA

N88-24176# Research Inst. of National Defence, Stockholm (Sweden).
SIMULATION: A SIMULATION SYSTEM IN Ada
Barbro Sjoeland and Magnus Sjoeland Nov. 1987 60 p In SWEDISH; ENGLISH summary
(FOA-A-20043-2.7; ISSN-0348-4580; ETN-88-92200) Avail: NTIS HC A04/MF A01

A simulation system consisting of a number of tools collected in an Ada package called Simulation is described. The general-purpose package can be used to solve problems from several areas. The simulation is basically constructed for discrete event simulation. The system was executed on a VAX 750 computer with Digital compiler and on an Apollo with Alsys's compiler. The function of the central processing unit is analyzed. ESA

N88-24177# Research Inst. of National Defence, Stockholm (Sweden).
DIALOG DESIGN: GENERAL REQUIREMENTS AND ANALYSIS OF AN Ada SYSTEM
Magnus Sjoeland Jan. 1988 34 p In SWEDISH; ENGLISH summary
(FOA-C-20691-2.7; ISSN-0347-3694; ETN-88-92203) Avail: NTIS HC A03/MF A01

The interaction between a user and a complex software system is analyzed and a set of requirements is presented. An Ada implementation of such an interface, called Dialog System (or

Diasys) was developed. It is a flexible tool, allowing the user to type parameterized commands to the system, tailored to the needs of that particular application. Diasys was successfully integrated with several software systems, one of which is used for the assessment of artillery systems. ESA

N88-24178# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
SIMULATION AND COMPUTER AIDED ENGINEERING (THE NECESSITY OF AN INTEGRATED APPROACH)
W. Loeve 1 Oct. 1986 21 p In DUTCH; ENGLISH summary
Presented at the Conference on Computer Aided Production and Engineering, Amsterdam, Netherlands, Mar. 1987
(NLR-MP-86050-U; B8733102; ETN-88-92222) Avail: NTIS HC A03/MF A01

It is argued that institutes for applied scientific research should use digital simulation methods for knowledge transfer to industry. This can be realized in an efficient way when the institutes assure that the methods are implemented in information systems that can be integrated into the infrastructure of interlocked elements for computer aided engineering (CAE) in industry. It is stressed that the infrastructures for information processing in the institutes for applied scientific research have to reflect the industrial infrastructure. In that case the infrastructure of the institute can serve as a testbed for the development of CAE tools. ESA

N88-24179# Royal Signals and Radar Establishment, Malvern (England).
DEVELOPMENT ENVIRONMENT FOR SECURE SOFTWARE
C. T. Sennett Nov. 1987 22 p
(RSRE-87015; BR104812; ETN-88-92512) Copyright Avail: NTIS HC A03/MF A01

Criteria to which a development environment should conform to be suitable for the production of secure software are given. A rationale for the criteria and a suitable security policy model for software development are outlined. ESA

N88-24180# Royal Signals and Radar Establishment, Malvern (England).
SEPARABILITY AND SECURITY MODELS
C. T. Sennett and R. Macdonald Nov. 1987 34 p
(RSRE-87020; BR105251; ETN-88-92513) Copyright Avail: NTIS HC A03/MF A01

Software security models are reviewed, and a detailed mathematical description of the property of separability, that is the property that certain software can be treated as though it were being obeyed in isolated computers is presented. The description uses the specification language Z, and the proofs required are given. ESA

N88-24181# Royal Signals and Radar Establishment, Malvern (England).
GENERIC CUEING IN IMAGE UNDERSTANDING
P. Fretwell, D. A. Bayliss, C. J. Radford, and R. W. Series Dec. 1987 14 p
(RSRE-Memo-4109; BR105255; ETN-88-92518) Copyright Avail: NTIS HC A03/MF A01

An attempt to derive simple low level features which may readily be extracted from an image is described. The features may be used to provide a classification of objects, so acting as a cue to aid further recognition. It is shown that such an approach may find applications in the early stages of image analysis for the classification of objects in an open world situation. The method is illustrated by application of classification rules based in an estimate of line wigglyness (fractal dimension) and analysis of the directional edgel statistics. ESA

N88-24182# Royal Signals and Radar Establishment, Malvern (England).
LINGUISTIC DEFINITION OF GENERIC MODELS IN COMPUTER VISION
P. Fretwell and P. J. Goillau Dec. 1987 12 p
(RSRE-Memo-4110; BR105253; ETN-88-92519; AD-A192036) Copyright Avail: NTIS HC A03/MF A01

A method that can take a human description of an object's spatial appearance and produce a PROLOG representation was developed. The object's appearance is in terms of an edge map and the English descriptions are stylized accounts of the salient features and combinations of features found in this representation. The translation is performed by hand. However, suggestions are made on how this process can be automated. A prototype translator was implemented. The PROLOG model is expressed as a hierarchy about the object's appearance, terminating in plausible low-level image primitives. A way of matching the hierarchy against an image for object recognition in isolation from its background is proposed. This reduces the search space of features and feature combinations that the matcher has to consider, so avoiding combinatorial problems when using PROLOG. Extensions using fuzzy logic to deal with uncertain image date and the vagueness of natural language are discussed. ESA

N88-24183# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
UNIFIED INTERCHANGE FORMAT FOR COMPUTER DATA (STANDARD FILE FORMAT)
L. Erup and W. R. Burke, ed. Jan. 1988 70 p
(ESA-STR-225; ISSN-0379-4067; ETN-88-92554) Copyright Avail: NTIS HC A04/MF A01

A general purpose standard format for computer files of numerical data was defined to facilitate the interchange of data between applications which treat related problems, thereby solving practical problems and enhancing the flexibility of a given software system. Data files in the standard format are portable between programming languages and computer systems. The standard does not make any assumptions about the nature of the data but it is mainly applicable to columnar data, i.e., data which describe the dependence of one or more variables on an independent variable. ESA

N88-24184*# Mitre Corp., Bedford, Mass.
MIPS: THE GOOD, THE BAD AND THE USEFUL
Jerry K. Richardson Jun. 1987 45 p Sponsored by NASA, Lyndon B. Johnson Space Center, Houston, Tex.
(Contract F19628-86-C-0001)
(NASA-CR-182893; JSC-22603; NAS 1.26:182893; MTR-10028)
Avail: NTIS HC A03/MF A01 CSCL 09B

Many authors are critical of the use of MIPS (Millions of Instructions per Second) as a measure of computer power. Some feel that MIPS are meaningless. While there is justification for some of the criticism of MIPS, sometimes the criticism is carried too far. MIPS can be a useful number for planning and estimating purposes when used in a homogeneous computer environmnet. Comparisons between published MIPS ratings and benchmark results reveal that there does exist a high positive correlation between MIPS and tested performance, given a homogeneous computer environment. MIPS should be understood so as not to be misused. It is not correct that the use of MIPS is always inappropriate or inaccurate Author

N88-24185*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE ENVIRONMENT FOR APPLICATION SOFTWARE INTEGRATION AND EXECUTION (EASIE) VERSION 1.0. VOLUME 4: SYSTEM INSTALLATION AND MAINTENANCE GUIDE
Donald P. Randall, Kennie H. Jones (Computer Sciences Corp., Hampton, Va.), and Lawrence F. Rowell Apr. 1988 50 p
(NASA-TM-100576; NAS 1.15:100576) Avail: NTIS HC A03/MF A01 CSCL 09B

The Environment for Application Software Integration and Execution (EASIE) provides both a methodology and a set of software utility programs to ease the task of coordinating engineering design and analysis codes. This document provides necessary information for installing the EASIE software on a host

computer system. The target host is a DEX VAX running VMS version 4; host dependencies are noted when appropriate. Relevant directories and individual files are identified, and compile/load/execute sequences are specified. In the case of the data management utilities, database management system (DBMS) specific features are described in an effort to assist the maintenance programmer in converting to a new DBMS. The document also describes a sample EASIE program directory structure to guide the program implementer in establishing his/her application dependent environment. Author

N88-24186 Iowa Univ., Iowa City.
A ROBOTIC LANGUAGE FOR COOPERATIVE MULTI-ROBOTS Ph.D. Thesis
Jong Soo Kim 1987 147 p
Avail: Univ. Microfilms Order No. DA8729479

A high-level robot control language is developed for cooperating multi-robot systems. When a cooperated task is compiled, the language gives the corresponding joint variable trajectories for all of the robot joints. Actual execution of the task is carried out by applying the joint trajectories to the robot controllers. As an option, the language can also give a simulation of the task as a 3-D color animation on a graphics terminal. Dissert. Abstr.

N88-24187*# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.
PARALLEL PROCESSORS AND NONLINEAR STRUCTURAL DYNAMICS ALGORITHMS AND SOFTWARE Semiannual Status Report, 1 May - 31 Oct. 1987
Ted Belytschko [1987] 48 p Submitted for publication NASA Research Grant NAG1-650, Supplement No. 2
(Grant NAG1-650)
(NASA-CR-182925; NAS 1.26:182925) Avail: NTIS HC A03/MF A01 CSCL 09B

An explicit-explicit subcycling procedure for the finite element analysis of structural dynamics is developed. This procedure has relaxed the usual constraint of requiring integer time step ratios for adjacent nodal groups. This allows for greater advantage to be taken of local stability criteria, and thus improves the efficiency of the explicit time integrator. Example problems are included to demonstrate the accuracy and stability of the method. Author

N88-24188*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THIRD CONFERENCE ON ARTIFICIAL INTELLIGENCE FOR SPACE APPLICATIONS, PART 2
Judith S. Denton, comp., Michael S. Freeman, comp., and Mary Vereen, comp. Jun. 1988 66 p Conference held in Huntsville, Ala., 2-3 Nov. 1987; sponsored by NASA, Marshall Space Flight Center, Huntsville, Ala. and Alabama Univ., Huntsville Sponsored by NASA, Washington
(NASA-CP-2492-Pt-2; M-576-Pt-2; NAS 1.55:2492-Pt-2) Avail: NTIS HC A04/MF A01 CSCL 09B

Topics relative to the application of artificial intelligence to space operations are discussed. New technologies for space station automation, design data capture, computer vision, neural nets, automatic programming, and real time applications are discussed. For individual titles, see N88-24189 through N88-24197.

N88-24189*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MTK: AN AI TOOL FOR MODEL-BASED REASONING
William K. Erickson and Mary R. Rudokas *In* NASA, Marshall Space Flight Center, Third Conference on Artificial Intelligence for Space Applications, Part 2 Jun. 1988 p 1-5 (For primary document see N88-24188 17-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

A 1988 goal for the Systems Autonomy Demonstration Project Office of the NASA Ames Research Office is to apply model-based representation and reasoning techniques in a knowledge-based system that will provide monitoring, fault diagnosis, control, and trend analysis of the Space Station Thermal Control System (TCS). A number of issues raised during the development of the first prototype system inspired the design and construction of a model-based reasoning tool called MTK, which was used in the building of the second prototype. These issues are outlined here with examples from the thermal system to highlight the motivating factors behind them, followed by an overview of the capabilities of MTK, which was developed to address these issues in a generic fashion. Author

N88-24190*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INTEGRATION OF SYMBOLIC AND ALGORITHMIC HARDWARE AND SOFTWARE FOR THE AUTOMATION OF SPACE STATION SUBSYSTEMS
Hugh Gregg, Kathleen Healey, Edmund Hack (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.), and Carla Wong *In* NASA, Marshall Space Flight Center, Third Conference on Artificial Intelligence for Space Applications, Part 2 Jun. 1988 p 7-14 Previously announced as N88-15497 (For primary document see N88-24188 17-61)
(Contract W-7405-eng-48)
Avail: NTIS HC A04/MF A01 CSCL 09B

Expert systems that require access to data bases, complex simulations and real time instrumentation have both symbolic and algorithmic needs. Both of these needs could be met using a general purpose workstation running both symbolic and algorithmic codes, or separate, specialized computers networked together. The later approach was chosen to implement TEXSYS, the thermal expert system, developed by the NASA Ames Research Center in conjunction with the Johnson Space Center to demonstrate the ability of an expert system to autonomously monitor the thermal control system of the space station. TEXSYS has been implemented on a Symbolics workstation, and will be linked to a microVAX computer that will control a thermal test bed. The integration options and several possible solutions are presented. Author

N88-24191*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONNECTING REMOTE SYSTEMS FOR DEMONSTRATION OF AUTOMATION TECHNOLOGIES
R. M. Brown and R. Yee *In* NASA, Marshall Space Flight Center, Third Conference on Artificial Intelligence for Space Applications, Part 2 Jun. 1988 p 15-23 (For primary document see N88-24188 17-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

An initial estimate of the communications requirements of the Systems Autonomy Demonstration Project (SADP) development and demonstration environments is presented. A proposed network paradigm is developed, and options for network topologies are explored. Author

N88-24192*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
KNOWLEDGE BASED SYSTEM VERIFICATION AND VALIDATION AS RELATED TO AUTOMATION OF SPACE STATION SUBSYSTEMS: RATIONALE FOR A KNOWLEDGE BASED SYSTEM LIFECYCLE
Keith Richardson and Carla Wong *In* NASA, Marshall Space Flight Center, Third Conference on Artificial Intelligence for Space Applications, Part 2 Jun. 1988 p 25-30 (For primary document see N88-24188 17-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

The role of verification and validation (V and V) in software has been to support and strengthen the software lifecycle and to ensure that the resultant code meets the standards of the requirements documents. Knowledge Based System (KBS) V and V should serve the same role, but the KBS lifecycle is ill-defined. The rationale of a simple form of the KBS lifecycle is presented, including accommodation to certain critical KBS differences from software development. Author

N88-24193*# Lockheed Missiles and Space Co., Greenbelt, Md.
TALOS: A DISTRIBUTED ARCHITECTURE FOR INTELLIGENT MONITORING AND ANOMALY DIAGNOSIS OF THE HUBBLE SPACE TELESCOPE
Bryant G. Cruse *In* NASA, Marshall Space Flight Center, Third Conference on Artificial Intelligence for Space Applications, Part 2 Jun. 1988 p 31-36 (For primary document see N88-24188 17-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

Lockheed, the Hubble Space Telescope Mission Operations Contractor, is currently engaged in a project to develop a distributed architecture of communicating expert systems to support vehicle operations. This architecture, named Telemetry Analysis Logic for Operating Spacecraft (TALOS), has the potential for wide applicability in spacecraft operations. The architecture mirrors the organization of the human experts within an operations control center. Author

N88-24194*# Environmental Research Inst. of Michigan, Ann Arbor.
ORBITAL NAVIGATION, DOCKING AND OBSTACLE AVOIDANCE AS A FORM OF THREE DIMENSIONAL MODEL-BASED IMAGE UNDERSTANDING
J. Beyer, C. Jacobus, and B. Mitchell *In* NASA, Marshall Space Flight Center, Third Conference on Artificial Intelligence for Space Applications, Part 2 Jun. 1988 p 37-46 (For primary document see N88-24188 17-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

Range imagery from a laser scanner can be used to provide sufficient information for docking and obstacle avoidance procedures to be performed automatically. Three dimensional model-based computer vision algorithms in development can perform these tasks even with targets which may not be cooperative (that is, objects without special targets or markers to provide unambiguous points). Role, pitch, and yaw of a vehicle can be taken into account as image scanning takes place, so that these can be correlated when the image is converted from egocentric to world coordinated. Other attributes of the sensor, such as the registered reflectance and texture channels, provide additional data sources for algorithm robustness. Author

N88-24195*# Alabama Univ., Huntsville. Center for Applied Optics.
GENETIC ALGORITHMS FOR ADAPTIVE REAL-TIME CONTROL IN SPACE SYSTEMS
J. vanderZijp and A. Choudry *In* NASA, Marshall Space Flight Center, Third Conference on Artificial Intelligence for Space Applications, Part 2 Jun. 1988 p 47-51 (For primary document see N88-24188 17-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

Genetic Algorithms that are used for learning as one way to control the combinational explosion associated with the generation of new rules are discussed. The Genetic Algorithm approach tends to work best when it can be applied to a domain independent knowledge representation. Applications to real time control in space systems are discussed. Author

N88-24196*# Florida International Univ., Miami. School of Computer Science.
AUTOMATIC PROGRAM GENERATION FROM SPECIFICATIONS USING PROLOG
Alex Pelin and Paul Morrow (Air Force Weapons Lab., Kirtland AFB, N. Mex.) *In* NASA, Marshall Space Flight Center, Third Conference on Artificial Intelligence for Space Applications, Part 2 Jun. 1988 p 53-57 Sponsored by AFOSR, Bolling AFB, Washington, D.C. (For primary document see N88-24188 17-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

An automatic program generator which creates PROLOG programs from input/output specifications is described. The generator takes as input descriptions of the input and output data types, a set of transformations and the input/output relation. Abstract data types are used as models for data. They are defined as sets of terms satisfying a system of equations. The tests, the transformations and the input/output relation are also specified by equations. Author

N88-24197*# Hamilton Standard, Windsor Locks, Conn.
TES: A MODULAR SYSTEMS APPROACH TO EXPERT SYSTEM DEVELOPMENT FOR REAL-TIME SPACE APPLICATIONS
Ralph Cacace and Brenda England *In* NASA, Marshall Space Flight Center, Third Conference on Artificial Intelligence for Space Applications, Part 2 Jun. 1988 p 59-63 (For primary document see N88-24188 17-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

A major goal of the Space Station era is to reduce reliance on support from ground based experts. The development of software programs using expert systems technology is one means of reaching this goal without requiring crew members to become intimately familiar with the many complex spacecraft subsystems. Development of an expert systems program requires a validation of the software with actual flight hardware. By combining accurate hardware and software modelling techniques with a modular systems approach to expert systems development, the validation of these software programs can be successfully completed with minimum risk and effort. The TIMES Expert System (TES) is an application that monitors and evaluates real time data to perform fault detection and fault isolation tasks as they would otherwise be carried out by a knowledgeable designer. The development process and primary features of TES, a modular systems approach, and the lessons learned are discussed. Author

N88-24198*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
A GENERIC MULTIBODY SIMULATION
K. A. Hopping and W. Kohn [1986] 27 p
(Contract NAS9-15800)
(NASA-CR-182949; NAS 1.26:182949) Avail: NTIS HC A03/MF A01 CSCL 09B

Described is a dynamic simulation package which can be configured for orbital test scenarios involving multiple bodies. The rotational and translational state integration methods are selectable for each individual body and may be changed during a run if necessary. Characteristics of the bodies are determined by assigning components consisting of mass properties, forces, and moments, which are the outputs of user-defined environmental models. Generic model implementation is facilitated by a transformation processor which performs coordinate frame inversions. Transformations are defined in the initialization file as part of the simulation configuration. The simulation package includes an initialization processor, which consists of a command line preprocessor, a general purpose grammar, and a syntax scanner. These permit specifications of the bodies, their interrelationships, and their initial states in a format that is not dependent on a particular test scenario. Author

N88-24199*# Illinois Univ., Urbana. Dept. of Computer Science.
MENTAT: AN OBJECT-ORIENTED MACRO DATA FLOW SYSTEM
Andrew S. Grimshaw and Jane W. S. Liu [1988] 21 p
(Grant NAG1-613)
(NASA-TM-101165; NAS 1.15:101165) Avail: NTIS HC A03/MF A01 CSCL 09B

Mentat, an object-oriented macro data flow system designed to facilitate parallelism in distributed systems, is presented. The macro data flow model is a model of computation similar to the data flow model with two principal differences: the computational complexity of the actors is much greater than in traditional data flow systems, and there are persistent actors that maintain state information between executions. Mentat is a system that combines the object-oriented programming paradigm and the macro data flow model of computation. Mentat programs use a dynamic structure called a future list to represent the future of computations. Author

N88-24200*# Maryland Univ., College Park.
MODELS AND METRICS FOR SOFTWARE MANAGEMENT AND ENGINEERING
V. R. Basili [1988] 12 p
(Grant NsG-5123)
(NASA-CR-182953; NAS 1.26:182953) Avail: NTIS HC A03/MF A01 CSCL 09B

This paper attempts to characterize and present a state of the art view of several quantitative models and metrics of the software life cycle. These models and metrics can be used to aid in managing and engineering software projects. They deal with various aspects of the software process and product, including resources allocation and estimation, changes and errors, size, complexity and reliability. Some indication is given of the extent to which the various models have been used and the success they have achieved. Author

N88-24201*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
GRAPHICS SOFTWARE TOOL FOR VT TERMINALS (VTGRAPH)
Caroline Wang Jun. 1988 45 p
(NASA-TM-100331; NAS 1.15:100331) Avail: NTIS HC A03/MF A01 CSCL 09B

VTGRAPH is a graphics software tool for using DEC/VT or VT compatible terminals. It allows the user to deal with computer environments which use VT terminals for window management and graphics systems. VTGRAPH was developed using the Re'Gis Graphics set and it was written in FORTRAN language. It provides window management and a PLOT10-like package plus color or shade capability. Author

N88-24202*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DESCRIPTION OF GRAPHICS TRANSLATION SOFTWARE BETWEEN INTERGRAPH AND TEKTRONIX SYSTEMS
Tom Rieckhoff, Jeff Hixson, and Mark Covan May 1988 11 p
(NASA-TM-100335; NAS 1.15:100335) Avail: NTIS HC A03/MF A01 CSCL 09B

The requirement for Marshall Space Flight Center's Photo Analysis to use existing 3-D Intergraph graphic files on an existing Tektronix 4129 3-D graphics workstation and the unavailability of an off-the-shelf Intergraph to Tektronix translator required the development of such a translater. Using the output of Intergraph's standard interchange format converter, the 3-D graphic information of Intergraph's files are reformatted and compressed. The 3-D image is reconstructed using Tektronix's software terminal interface graphic library (STI). Author

N88-24203*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PARALLEL DISCRETE-EVENT SIMULATION OF FCFS STOCHASTIC QUEUEING NETWORKS Final Report
David M. Nicol (College of William and Mary, Williamsburg, Va.) May 1988 23 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181669; ICASE-88-29; NAS 1.26:181669) Avail: NTIS HC A03/MF A01 CSCL 09B

Physical systems are inherently parallel. Intuition suggests that simulations of these systems may be amenable to parallel execution. The parallel execution of a discrete-event simulation requires careful synchronization of processes in order to ensure the execution's correctness; this synchronization can degrade performance. Largely negative results were recently reported in a study which used a well-known synchronization method on queueing network simulations. Discussed here is a synchronization method (appointments), which has proven itself to be effective on simulations of FCFS queueing networks. The key concept behind appointments is the provision of lookahead. Lookahead is a prediction on a processor's future behavior, based on an analysis of the processor's simulation state. It is shown how lookahead can be computed for FCFS queueing network simulations, give performance data that demonstrates the method's effectiveness under moderate to heavy loads, and discuss performance tradeoffs between the quality of lookahead, and the cost of computing lookahead. Author

N88-23795# Naval Weapons Center, China Lake, Calif.
DEVELOPING SYSTEMS USING STATE-OF-THE-ART CAD/CAM TECHNOLOGY
Vernon A. Anderson and David J. Brewer (Space and Naval Warefare Systems Command, Charleston, S.C.) *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 7 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

N88-23798# British Aerospace Public Ltd. Co., Preston (England). Military Aircraft Div.
SOFTWARE ENGINEERING FOR THE BRITISH AEROSPACE EXPERIMENTAL AIRCRAFT PROGRAMME (EAP)
W. E. R. Kellaway *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 14 p Sponsored in part by the Ministry of Defence, United Kingdom (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

N88-23800# General Research Corp., Santa Barbara, Calif.
A SOFTWARE LIFE CYCLE SUPPORT ENVIRONMENT
L. Y. Bajwa and Frank S. LaMonica (Rome Air Development Center, Griffiss AFB, N.Y.) *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 19 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

N88-24008# Meteorological Satellite Center, Tokyo (Japan).
VISSR LINE NUMBER MONITORING SYSTEM
Masaaki Sugai and Toshio Onigata *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 39-47 In JAPANESE; ENGLISH summary (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

N88-24009# Meteorological Satellite Center, Tokyo (Japan).
SOME PROBLEMS WITH REGARD TO THE TOVS PROCESSING DETECTED BY USING NOAA-HRPT DATA CHECK PROGRAM
Yoshiaki Takeuchi *In its* Meteorological Satellite Center Technical Note No. 16 1988 p 49-58 In JAPANESE; ENGLISH summary (For primary document see N88-24003 17-42)
Avail: NTIS HC A05/MF A01

N88-24079# Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
COMTAL VISION ONE/20 PROGRAMMING PROCESSOR SYSTEM FROM THE VAX 11/780 [PROGRAMACION DEL PROCESADOR DEL SISTEMA COMTAL VISION ONE/20 DESDE VAX-11/780]
A. Sedeno *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 665-668 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24082# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
APPLICATION OF ITS TRANSFORMATION IN COLOR ENHANCEMENT OF LANDSAT IMAGERY [APLICADAO DA TRANSFORMACAO IHS PARA REALCE DE CORES EM IMAGENS LANDSAT]
Luciano Vieira Dutra and Paulo Roberto Meneses *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 675-681 In PORTUGUESE: ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24365# Idaho National Engineering Lab., Idaho Falls.
EXPERT SYSTEMS APPROACH TO MODELING SYSTEMS WITH THE ATHENA THERMAL-HYDRAULICS CODE
R. K. Fink, R. A. Callow, V. H. Ransom, and T. K. Larson *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 485-488 (For primary document see N88-24254 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A22/MF A01

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N88-24204 New South Wales Univ., Kensington (Australia).
A FIVE-LAYER OPEN SYSTEMS INTERCONNECTION (OSI) IMPLEMENTATION M.S. Thesis Abstract Only
Dean Gingell Feb. 1987 37 p
Avail: Issuing Activity

The Open Systems Interconnection (OSI) model is a standardized architecture for communication between heterogeneous information processing systems. An implementation of real protocols within the OSI architecture based on the Teletex service is described. The Teletex service is an end to end terminal document exchange service, which may operate over various switched networks. It uses 5 of the 7 layers of the OSI model to provide full error correction, checkpointing, and document format control. The OSI transport and session layers for Teletex are standardized by the CCITT recommendations T.70 and T.62, respectively. These recommendations were transcribed with little change to become generic transport and session layer protocols as CCITT recs. X.224 and X.225, which are becoming increasingly popular for other applications. The network layer chosen for this implementation is based on CCITT rec X.25 (for public packet data networks). The design for X.25 layer is based on an HDLC chip interfaced to the 68008 processor bus. The software for protocol communication is written in the Forth language which proved well suited to the task. A user interface written in Pascal provides convenient access to the terminal processes. Author

N88-24205 New South Wales Univ., Kensington (Australia). Dept. of Computer Science.
INTERCONNECTION OF HIGH-SPEED LOCAL AREA NETWORKS M.S. Thesis Abstract Only
A. J. S. deSilva Oct. 1987 92 p
Avail: Issuing Activity

A means to interconnect two High-Speed Local Area Networks was designed. The two networks are NSC HYPERchannel and CDC Loosely Coupled Network. The purpose of the interconnection is to enable data transfers to be carried out across the two networks, such that the network differences are transparent. The native access protocols of the two networks are not compaticle with the ISO Open Systems Interconnect (OSI) reference model. It was also the aim to investigate whether a means to interconnect the networks can be found in the context of the ISO OSI model and whether it is feasible to create an OSI environment above the native network protocols. The investigations revealed that it is feasible to find a means to interconnect the two networks in the context of the OSI model and to create an OSI environment to co-exist with the native protocol environments. The design of the interconnect solution is presented. The protocol chosen for the internetwork layer is the new ISO OSI connectionless Internetwork Protocol (IP). Also described is the prototyping work carried out to verify certain design aspects and performance projections. Some special protocol requirements unique to high-speed networks are identified and recommendations made to enhance the OSI OP protocol to support these features. Author

N88-24206*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, Calif.
AEROSPACE ENERGY SYSTEMS LABORATORY: REQUIREMENTS AND DESIGN APPROACH
Richard D. Glover May 1988 12 p Presented at the ISA Aerospace Industries/Test Measurement Symposium, Albuquerque, N. Mex., 2-5 May 1988
(NASA-TM-100423; H-1448; NAS 1.15:100423) Avail: NTIS HC A03/MF A01 CSCL 09B

The NASA Ames-Dryden Flight Research Facility at Edwards, California, operates a mixed fleet of research aircraft employing nickel-cadmium (NiCd) batteries in a variety of flight-critical applications. Dryden's Battery Systems Laboratory (BSL), a computerized facility for battery maintenance servicing, has developed over two decades into one of the most advanced facilities of its kind in the world. Recently a major BSL upgrade was initiated with the goal of modernization to provide flexibility in meeting the needs of future advanced projects. The new facility will be called the Aerospace Energy Systems Laboratory (AESL) and will employ distributed processing linked to a centralized data base. AESL will be both a multistation servicing facility and a research laboratory for the advancement of energy storage system maintenance techniques. This paper describes the baseline requirements for the AESL and the design approach being taken for its mechanization. Author

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N88-24207# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes.
SIMULTANEOUS USE OF ARTIFICIAL INTELLIGENCE AND PETRI NETS: APPLICATION TO THE MONITORING OF A FABRICATION PLAN Ph.D. Thesis - Paul Sabatier Univ.
Homa AtabakhcheFallahi 1987 196 p In FRENCH; ENGLISH summary
(LAAS-87-354; ETN-88-92170) Avail: NTIS HC A09/MF A01

Simultaneous use of artificial intelligence techniques and graphic approaches such as Petri nets, for an application to the real time control of manufacturing systems was studied. Problems related to the monitoring of a fabrication plan in a flexible manufacturing system are described. The main types of colored and high level Petri nets are compared. An analogy is made between the two approaches to show their similarities. A model compatible with both approaches is proposed: decision Petri nets. The model is implemented by a software written in LE-LISP. The traditional implementation mechanisms for Petri nets are introduced into a rule-based system, allowing it to represent knowledge in a different manner as that of places and transitions in a Petri net. ESA

N88-24208# Research Inst. of National Defence, Linkoeping (Sweden).
NOTES ON ARTIFICIAL INTELLIGENCE. PART 1: TECHNICAL FORECAST
Dan Stroemberg May 1987 21 p In SWEDISH; ENGLISH summary
(FOA-C-30448-3.3-Pt-1; ISSN-0347-3708; ETN-88-92204) Avail: NTIS HC A03/MF A01; Research Institute of National Defence, Box 11105, S-581 11 Linkoping, Sweden, 50 Swedish crowns

Artificial Intelligence (AI) is reviewed. Conclusions are: general problems cannot be solved; AI auxiliary systems can be important for total defense (civil and military) e.g., for raising alarm; it implies the implementation of special tools for the handling, simulation, and decision making. Typical of defense problems is to treat a great number of signals from different types of sensors. There is a trend for hypothesis-oriented signal interpretation, for certain

specific problems, e.g., signal integration from submarines. Vulnerability is proportional to the complexity of the system: aging or breaking of transmission lines. ESA

N88-24209# Oxford Univ. (England). Dept. of Engineering Science.
GENERALIZED PREDICTIVE CONTROL OF MULTIVARIABLE SYSTEMS
C. Mohtadi, S. L. Shah, and D. W. Clarke 1986 20 p
(OUEL-1640/86; ETN-88-92530) Avail: NTIS HC A03/MF A01

The multivariable extension of the generalized predictive control strategy of Clarke et al., (1984) is considered. It is formally shown that subject to a suitable choice of (finite) output and control horizons a quadratic cost function is minimized without any prior knowledge of the system delay matrix. Simulation results on two multivariable systems demonstrate the validity of the method. ESA

N88-24210# Oxford Univ. (England). Dept. of Engineering Science.
AN ALGORITHM FOR SUPER-OPTIMAL H SUP INF DESIGN: THE 2-BLOCK CASE
D.-W. Gu, M. C. Tsai, and I. Postlethwaite 1987 23 p
(OUEL-1711/87; ETN-88-92532) Avail: NTIS HC A03/MF A01

The strengthened H sup inf optimization problem in the 2-block case is considered. An algorithm for the super-optimal solution is proposed. It is based on results by Gu, Tsai, and Postlethwaite (1987) for the less practical 1-block case. It uses state-space models and is numerically implementable. A feature of the procedure is an optimality criterion which is a natural generalization of that used in the iterative scheme of Doyle (1984) for the unstrengthened problem. ESA

N88-24211# Oxford Univ. (England). Dept. of Engineering Science.
A STATE-SPACE APPROACH TO DISCRETE-TIME SUPER-OPTIMAL H SUP INF CONTROL PROBLEMS
I. Postlethwaite, M. C. Tsai, and D.-W. Gu 1987 29 p
(OUEL-1712/87; ETN-88-92533) Avail: NTIS HC A03/MF A01

An algorithm for solving the strengthened discrete-time 1-block model-matching problem is presented. All the steps of the algorithm are performed using state-space models and each step has a closed-form solution. The uniqueness of the super-optimal solution follows from the constructions in the algorithm. By working completely in discrete-time, the super-optimal controller can be analyzed explicitly in the z-domain and implemented directly on a digital computer. ESA

N88-24212 Lehigh Univ., Bethlehem, Pa.
A CONTROL TECHNIQUE FOR IMPROVED ROBOT PERFORMANCE Ph.D. Thesis
Michael Robert Tucker 1987 202 p
Avail: Univ. Microfilms Order No. DA8729542

A calibration/correction technique which improves the overall performance and ability to program robotic systems was developed. A system which implements the technique was constructed. The technique improves a robot's accuracy at its ending position and orientation by eliminating the effects of the pose placement error sources such as unknowns in the robot's linkage parameters. An accurate model of the robot is created by commanding the robot to a series of desired poses and measuring the difference between the desired and achieved pose. A calibration algorithm is then used to determine the kinematic parameter errors of the robot. A sensor was developed to measure pose difference to an accuracy of 1/1000 in. When the robot is commanded to a pose during its normal operation, a correction algorithm uses the accurate robot model to predict the anticipated pose placement errors and to generate joint corrections which when added to the joint solutions obtained by the robot's controller, cause the end effector pose to be nearly equal to the commanded pose. Dissert. Abstr.

N88-24213*# Houston Univ., Tex. Dept. of Electrical Engineering.
PRECISE COMPUTER CONTROLLED POSITIONING OF ROBOT END EFFECTORS USING FORCE SENSORS Final Report, 1 Jan. 1987 - 30 Jun. 1988
L. S. Shieh, B. C. McInnis, and J. C. Wang (Idaho State Univ., Pocatello.) 15 Jun. 1988 40 p
(Grant NAG9-211)
(NASA-CR-182887; NAS 1.26:182887) Avail: NTIS HC A03/MF A01 CSCL 09B

A thorough study of combined position/force control using sensory feedback for a one-dimensional manipulator model, which may count for the spacecraft docking problem or be extended to the multi-joint robot manipulator problem, was performed. The additional degree of freedom introduced by the compliant force sensor is included in the system dynamics in the design of precise position control. State feedback based on the pole placement method and with integral control is used to design the position controller. A simple constant gain force controller is used as an example to illustrate the dependence of the stability and steady-state accuracy of the overall position/force control upon the design of the inner position controller. Supportive simulation results are also provided. Author

N88-24495# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
AN OPTIMAL DISTURBANCE REJECTION CONTROL SYSTEM FOR MULTIMEGAWATT SPACE NUCLEAR POWER SYSTEMS
Alexander G. Parlos *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 595-598 Sponsored in part by NSF, Washington, D.C. and MIT, Cambridge (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N88-24214# Vibration Inst., Clarendon Hills, Ill.
THE SHOCK AND VIBRATION DIGEST, VOLUME 20, NO. 4 Monthly Report
Judith Nagle-Eshleman, ed. Apr. 1988 68 p
Avail: NTIS HC A04/MF A01

The feature article concerns true space-time finite element analysis. Abstracts from the current shock and vibration literature are presented. Other features include book reviews, reviews of meetings, and standards news. For individual titles, see N88-24215 through N88-24215.

N88-24215# Institut National Polytechnique, Nancy (France). Lab. de Recherches et Applications en Macanique Assistee par Ordinateur.
STATE-OF-THE-ART IN TRUE SPACE-TIME FINITE ELEMENT METHOD
Czeslaw I. Bajer and C. G. Bonthoux *In* Vibration Inst., The Shock and Vibration Digest, Volume 20, No. 4 Apr. 1988 p 3-11 (For primary document see N88-24214 17-64)
Avail: NTIS HC A04/MF A01

The space-time finite element method is rarely used in solutions of engineering dynamic problems. Classic time integration methods are usually included in computational procedures. However, nonstationary spatial discretization cannot be assumed when spatial and time domains are separated. Recent developments of the finite space-time element method allow application of approximation techniques to the spatial and time domains. Special schemes lead to highly efficient algorithms that consider both memory requirements and number of arithmetical operations. Recent work in the field of space-time elements applied to structural dynamics is described. Some comparisons and relations to other computational methods are made. Author

N88-24216# Stanford Univ., Calif. Dept. of Statistics.
IMPROVED ESTIMATORS IN SIMULTANEOUS ESTIMATION OF SCALE PARAMETERS
Dipak K. Dey and Alan E. Gelfand 10 Dec. 1987 25 p
(Contract N00014-86-K-0156)
(AD-A191108; TR-399) Avail: NTIS HC A03/MF A01 CSCL 12C

A general class of estimators is developed for improving upon best scale invariant estimators of two or more arbitrary scale parameters (or powers thereof) for arbitrary positive distributions with sufficient moments under weighted squared error loss function. The technique is to compute the risk difference in terms of moments of the distribution. Some conditions are obtained under which the maximum improvement is possible, and the form of the estimator can be chosen to achieve this maximum along any specified ray. The result is then extended to the estimation of a linear transform of the parameter vector. Finally, some examples are given with numerical calculations to obtain the amount of risk improvement. GRA

N88-24217*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFICIENT IMPLEMENTATION OF ESSENTIALLY NON-OSCILLATORY SHOCK CAPTURING SCHEMES, 2 Final Report
Chi-Wang Shu and Stanley Osher (California Univ., Los Angeles.) Apr. 1988 64 p Submitted for publication Sponsored in part by Defense Advanced Research Projects Agency, Arlington, Va.
(Contract NAS1-18107; Grant NAG1-270)
(NASA-CR-181656; ICASE-88-24; NAS 1.26:181656) Avail: NTIS HC A04/MF A01 CSCL 12A

Earlier work on the efficient implementation of ENO (essentially non-oscillatory) shock capturing schemes is continued. A new simplified expression is provided for the ENO construction procedure based again on numerical fluxes rather than cell averages. Also considered are two improvements which are labeled ENO-LLF (local Lax-Friedrichs) and ENO-Roe, which yield sharper shock transitions, improved overall efficiency, and lower computational cost than previous implementation of the ENO schemes. Two methods of sharpening contact discontinuities, i.e., the subcell resolution idea of Harten and the artificial compression idea of Yang, which those authors used originally in the cell-average framework, are supplied to the current ENO schemes using numerical fluxes and TVD Runge-Kutta time discretizations. The implementation for nonlinear systems and multi-dimensions is given. Finally, many numerical examples, including a compressible shock turbulence interaction flow calculation, are given. Author

N88-24218# Institut National Polytechnique, Grenoble (France).
APPLICATION OF SPLINE FUNCTIONS TO DIGITAL IMAGE PROCESSING Ph.D. Thesis [APPLICATION DES FONCTIONS-SPLINE AU TRAITEMENT D'IMAGES NUMERIQUES]
Philippe Cinquin 1987 158 p In FRENCH
(ETN-88-92194) Avail: NTIS HC A08/MF A01

A method for continuous modeling of images to be processed and for parameter estimation is proposed. It is based on spline functions (tensor products of one dimensional splines and polyhedric B-splines). Approximation algorithms to cope with the large amount of data were developed. Three medical applications are illustrated: segmentation of cytological images; numerical estimation of the confines of certain biological systems; and visualization, segmentation, and modeling of three dimensional images obtained by tomodensimetry and magnetic resonance imaging. ESA

N88-24219# Grenoble-1 Univ., Saint Martin d'Heres (France). Lab. d'Informatique Fondamentale et d'Intelligence Artificielle.
ON A CLASSIFICATION OF PROBLEMS ON SETS OF BILINEAR FORMS BY FORMAL POLYNOMIALS
Philippe Chatelin Jan. 1987 16 p
(RR-642-I-IMAG-53-LIFIA; ETN-88-92277) Avail: NTIS HC A03/MF A01

Formal polynomials built on the indices of sets of bilinear forms are defined and a calculus on them exemplified. They classify two kinds of problems: How to establish a hierarchy depending on the invariance property of their places by circular permutations (orbital and cubic forms); and in the known cases, optimal algorithms related to orbital forms are orbital (up to a trilinear transformation). ESA

N88-24220# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.
ADJUSTING A FINITE ELEMENT MODEL USING VIBRATION TYPE EXPERIMENTAL DATA. CONCEPT AND ERROR DETECTION Final Report [RECALAGE D'UN MODELE PAR ELEMENTS FINIS A PARTIR DE DONNEES EXPERIMENTALES DU TYPE VIBRATOIRE. CONCEPT DE LOCALISATION D'ERREURS]
H. Berger, L. Barthe, and R Ohayon May 1987 39 p In FRENCH
(Contract DRET-86-34-001)
(ONERA-RT-7/3313-RY-060-R; ETN-88-92293) Avail: NTIS HC A03/MF A01

A method for correcting finite element models using vibration test data, in which the degrees of freedom not measured are calculated such that the corresponding reaction forces in the dynamic equilibrium equation of the calculation model supposed to be in error are non-null, is presented. The method detects dominant errors and is of relatively simple numerical application, employing quadratic optimization with no constraints at each iteration. A numerical application to a lattice structure simulated gives good results. ESA

N88-24221# Sheffield Univ. (England). Dept. of Control Engineering.
EXISTENCE OF PERIODIC SOLUTIONS IN n-DIMENSIONAL RETARDED FUNCTIONAL DIFFERENTIAL EQUATIONS
S. P. Banks 1988 15 p
(RR-325; ETN-88-92524) Avail: NTIS HC A03/MF A01

The existence of periodic orbits of n-dimensional delay systems of the form x-bar(t) = -f(x(t-p)) is proved and applied to systems of the form x-dot(t) = -x(t-1)N(x(t)), and a cerain type of Hamiltonian system. ESA

N88-24222# Sheffield Univ. (England). Dept. of Control Engineering.
A RECURSIVE PREDICTION ERROR PARAMETER ESTIMATOR FOR NONLINEAR MODELS
S. Chen and S. A. Billings Mar. 1987 30 p
(Grant SERC-GR/D/30587)
(RR-326; ETN-88-92525) Avail: NTIS HC A03/MF A01

A recursive prediction error parameter estimation algorithm is derived for systems which can be represented by the nonlinear ARMAX model. A convergence analysis is presented using the differential equation approach and the concept of m-invertibility is introduced. The analysis shows that while a highly nonlinear process model may be used to capture the nonlinearity of the system it is advisible to fit a simple noise model. The results of applying the algorithm to simulated and real data are included. ESA

N88-24223 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
FITTING A CIRCLE TO RADIALLY SUPPRESSED DATA
Alistair B. Forbes Dec. 1987 18 p
(NPL-DITC-103/87; ISSN-0262-5369; ETN-88-92528) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

The problem of finding the center of the best fit circle to radially suppressed data is modeled as a four parameter nonlinear least squares problem with bound constraints on one of the parameters. Applications include automatic calibration of a ball plate using a three-coordinate measuring machine. Numerical stability is analyzed, and a Gauss-Newton iterative algorithm to find the best-fit

circle center and radius is outlined. Analysis shows that with suitable scaling the model is numerically stable, especially if the data is well distributed around the circle. If the circle is centered near the origin, the radius becomes poorly determined by the data and the bound constraints on the radius are likely to become active. The limacon approximation gives good starting values for the algorithm, especially if e/R is small. In circumstances where this ratio is guaranteed to be small, the limacon approximation can be adequate for most purposes. However, the four parameter algorithm is more accurate, significantly so if the workpiece is not centered near the origin. ESA

N88-24224 National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
COINCIDENCE COUNTING CORRECTIONS UNDER CONDITIONS USED BY A. DEVOLPI
David Smith Jan. 1988 31 p
(NPL-RS(EXT)90; ISSN-0143-7135; ETN-88-92529) Copyright
Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

Exact and high-order approximate formulae are derived for coincidence counting corrections for unsual conditions used by A. DeVolpi (1986). The formulae are an extension of the theory of Cox-Isham (1977) and Smith and are valid for nonextending dead times. In the case of extending dead times, the same formulae are not strictly applicable, although at low count rates, they are a good approximation. The essential part of the Monte Carlo program and an associated flow diagram are given for both the conditions used by DeVolpi and for traditional conditions. Results from simulations confirm the validity of the formulae. ESA

N88-24225 Purdue Univ., West Lafayette, Ind.
STATE COVARIANCE ASSIGNMENT OF DISCRETE SYSTEMS: DEVELOPMENT AND APPLICATIONS Ph.D. Thesis
Emmanuel Gye Collins, Jr. 1987 160 p
Avail: Univ. Microfilms Order No. DA8729729

Past approaches to developing control laws for constrained variance objectives have been indirect. Iterative schemes used to determine the weights in the linear quadratic (LQ) cost functional have two deficiencies: (1) it has not been proved that weights exist which will satisfy the variance requirements even if a satisfying controller is known to exist a priori; and (2) the iterative schemes which have been developed to search for the weights are not proven to converge. It is possible to meet the output variance requirements by assigning a specified state covariance to the system. The following (state covariance assignment) problems for linear discrete-time systems is introduced and solved: (1) characterize the entire set of state covariances which may be assigned to a system by state feedback; and (2) find the set of all state feedback gains which will assign an admissible state covariance to the system. Dissert. Abstr.

N88-24226 New South Wales Univ., Sydney (Australia).
A NEW COLLOCATION-TYPE METHOD FOR THE NUMERICAL SOLUTION OF HAMMERSTEIN EQUATIONS Ph.D. Thesis Abstract Only
Sunil Kumar Apr. 1987 75 p
Avail: Issuing Activity

A method that approximates the solution y of the Hammerstein equation y(t) = f(t) + the integral (limits a and b) k(t,s)g(s,y(s))ds, where t is an element of the closed interval (a,b), is presented. The method first applies the standard collocation method to an equivalent equation for z(t):=g(t,y(t)). It then obtains the approximation to y by using the equation y(t) = f(t) + the integral (limits a and b) k(t,s)z(s)ds. Let z(sub n) and y(sub n) be the approximations to z and y respectively. It is proved that, under suitable conditions, y(sub n) converges to y at a rate at least equal to that of the best approximation to z from the space in which z(sub n) is sought. In particular, it is shown that if z(sub n) is sought in certain piecewise polynomial function spaces, then y(sub n) may exhibit (global) superconvergence, that is, it may converge to y at a faster rate than z(sub n) does to z. The discrete version of the method, which arises when numerical quadrature is used to approximate required integrals, is analyzed for interpolatory quadrature rules and piecewise polynomial approximations to z. The analysis shows that the discrete approximation to z has the same order of convergence as its exact counterpart if k is sufficiently smooth, and if the quadrature rule is of sufficient precision. The method is used in the computation of a simple turning point of a parameter-dependent equation. Author

N88-24227 New South Wales Univ., Kensington (Australia).
MAHLER'S METHOD IN TRANSCENDENCE THEORY Abstract Only. Ph.D. Thesis
David Angell 1987 79 p
Avail: Issuing Activity

In 1926 Kurt Mahler introduced functional equation methods into transcendence theory. His work went largely unnoticed until almost fifty years later, when it was taken up by Loxton and van der Poorten and others. The method is particularly well suited for investigating the transcendence of numbers whose decimal expansions in some base g larger than or = 2 can be produced by a finite automaton (a computer with a fixed, finite amount of memory). This bears upon the question of whether or not the expansion of an algebraic irrational need be random. A simple transcendence proof is given in order to illustrate the scope and limitations of a variant of this method. Also demonstrated is an algebraic independence theorem which relates the algebraic independence of a collection of power series f(z) which satisfy a certain type of functional equation to the algebraic independence of the numbers f(alpha) for a suitable algebraic number alpha. The theorem, while giving a more general result than that of Loxton and van der Poorten, is proved by more economical means than those of Kubota. Author

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N88-24228# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
ALMOST SURE L(GAMMA)-NORM CONVERGENCE FOR DATA-BASED HISTOGRAM DENSITY ESTIMATES Technical Report, Aug. 1987
L. C. Zhao, P. R. Krishnaiah, and X. R. Chen Aug. 1987 27 p
(Contract F49620-85-C-0008; AF Proj. 2304)
(AD-A189944; TR-87-30; AFOSR-87-1843TR) Avail: NTIS HC A03/MF A01 CSCL 12C

Let X1,...,Xn be i.i.d. samples drawn from a d-dimensional distribution with density f. Partition the space R(sub d) into a union of disjoint intervals I(sub l) = I(l,X1,...,Xn) with the form I(sub l) = (x = (x(1),...,x(d): - infinity is less than a(sub li) is less than or = x(i) which is less than or = b(sub li) which is less than infinity, i = 1,...,d). Define the data-based histogram estimate of f(x) based on this partition as fn(x) = the number of X1,...,Xn falling into I(sub l) divided by n times the volume of I(sub l), for x being an element of I(sub l), and l = 1,2... For the given constant r is greater than or = 1 we obtain the sufficient condition for the limit (as n approaches infinity) of the integral R(sub d) of the absolute value of (f sub n(x) - f(x)) to the rth power dx = O. The results give substantial improvements upon existing results. GRA

N88-24229# Stanford Univ., Calif. Dept. of Statistics.
ON HOTELLING'S APPROACH TO TESTING FOR A NONLINEAR PARAMETER IN REGRESSION
Mark Knowles and David Siegmund Jan. 1988 25 p
(Contract N00014-87-K-0078; Grant NSF DMS-86-02335)
(AD-A191189; TR-6) Avail: NTIS HC A03/MF A01 CSCL 12C

The method suggested by Hotelling (1939) to test for a nonlinear parameter in a regression model is reviewed. Using the method of Weyl (1939), we derive a simple expression for the volume of a tube about a two dimensional manifold with boundary embedded in the unit sphere in l delta R sub n. Applications to testing for a

single harmonic of undetermined frequency and phase and to testing for a change-point in linear regression are discussed. GRA

N88-24230*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INDUCTION OF MODELS UNDER UNCERTAINTY
Peter Cheeseman [1986] 15 p
(NASA-TM-101173; NAS 1.15:101173) Avail: NTIS HC A03/MF A01 CSCL 12A

This paper outlines a procedure for performing induction under uncertainty. This procedure uses a probabilistic representation and uses Bayes' theorem to decide between alternative hypotheses (theories). This procedure is illustrated by a robot with no prior world experience performing induction on data it has gathered about the world. The particular inductive problem is the formation of class descriptions both for the tutored and untutored cases. The resulting class definitions are inherently probabilistic and so do not have any sharply defined membership criterion. This robot example raises some fundamental problems about induction; particularly, it is shown that inductively formed theories are not the best way to make predictions. Another difficulty is the need to provide prior probabilities for the set of possible theories. The main criterion for such priors is a pragmatic one aimed at keeping the theory structure as simple as possible, while still reflecting any structure discovered in the data. Author

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N88-24231# Los Alamos National Lab., N. Mex.
FREE ELECTRON LASERS IN STRATEGIC DEFENSE
G. H. Canavan and J. C. Browne Mar. 1988 29 p
(Contract W-7405-eng-36)
(DE88-007024; LA-11225-MS) Avail: NTIS HC A03/MF A01

This report discusses the basis for free electron laser (FEL) operation, roles FELs could play in strategic defense, expected effectiveness, and status of key components. The constellation sizes needed to meet evolving threats are derived, and the tradeoffs between space and ground basing of FELs are discussed, leading to a conclusion that FELs could be available for and play complementary roles to those of kinetic energy concepts. DOE

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N88-24232# Cologne Univ. (West Germany). Inst. fuer Geophysik und Meteorologie.
AN INTRODUCTION TO POLOIDAL AND TOROIDAL FIELDS
Dieter A. Wolf-Gladrow, A. Ebel, ed., F. M. Neubauer, ed., E. Raschke, ed., and P. Speth, ed. 1987 14 p
(Mitt-54; ISSN-0069-5882; ETN-88-92347) Avail: NTIS HC A03/MF A01

The properties of poloidal and toroidal vector fields and their associated potentials (scalars) in spherical coordinates are reviewed. The magnetic field of a given current density distribution is calculated by means of these fields (uncurling Ampere's law). Poloidal and toroidal fields in general geometries are discussed. In contrast to spherical coordinates, the curl of a poloidal field is in general not toroidal. Explicit formulas are given for rectangular and cylindrical coordinates. Suggestions for geophysical applications are included. ESA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

No abstracts in this category.

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N88-24233*# Cambridge Acoustical Associates, Inc., Mass.
ANALYTICAL MODELING OF THE STRUCTUREBORNE NOISE PATH ON A SMALL TWIN-ENGINE AIRCRAFT
J. E. Cole, III, A. Westagard Stokes, J. M. Garrelick, and K. F. Martini Washington NASA Jun. 1988 127 p
(Contract NAS1-18020)
(NASA-CR-4136; NAS 1.26:4136; U-1541-349-Pt-1) Avail: NTIS HC A07/MF A01 CSCL 20A

The structureborne noise path of a six passenger twin-engine aircraft is analyzed. Models of the wing and fuselage structures as well as the interior acoustic space of the cabin are developed and used to evaluate sensitivity to structural and acoustic parameters. Different modeling approaches are used to examine aspects of the structureborne path. These approaches are guided by a number of considerations including the geometry of the structures, the frequency range of interest, and the tractability of the computations. Results of these approaches are compared with experimental data. Author

N88-24234# Federal Aviation Administration, Washington, D.C.
ADVISORY CIRCULAR: NOISE CERTIFICATION HANDBOOK
23 Mar. 1988 66 p
(FAA-AC-36-4B) Avail: NTIS HC A04/MF A01

The aim of this technical manual is to promote uniformity of implementation of the noise certification requirement of Part 36 of the Federal Aviation Regulations (FAR) by presenting test, analysis, and documentration procedures for subsonic turbojet airplanes that were determined by the FAA to be technically acceptable for demonstrating compliance with that regulation. Where appropriate, FAA policy governing such certifications is reviewed. Author

N88-24235# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de la Physique Generale.
STUDY OF THE CONVERGENCE OF A FINITE DIFFERENCE SCHEME FOR ACOUSTIC PROPAGATION IN THE ATMOSPHERE IN A PARABOLIC APPROXIMATION. STATISTICAL CALCULATION OF THE SOUND FIELD IN THE PRESENCE OF KINEMATIC TURBULENCE [ETUDE DE LA CONVERGENCE DU SCHEMA AUX DIFFERENCES FINIES POUR LA PROPAGATION ACOUSTIQUE ATMOSPHERIQUE A L'APPROXIMATION PARABOLIQUE. CALCUL STATISTIQUE DU CHAMP SONORE EN PRESENCE D'UNE TURBULENCE CINEMATIQUE]
P. Malbequi May 1987 63 p In FRENCH
(Contract DRET-86-001)
(ONERA-RS-8/3641-PY-160-P; ETN-88-92295) Avail: NTIS HC A04/MF A01

The convergence of a finite element method used to study parabolic propagation of sound in the atmosphere was examined. The purely implicit scheme converges well and is unconditionally stable. With a sufficiently fine grid, a quadratic error less than 0.5 percent is possible. The numerical application of the Monte Carlo method for the moments of a sound field in the presence of kinematic turbulence is discussed. An example of propagation processed with an effective turbulence value oversized in relation to reality because of the space taken up in the memory by the

spatial filter allowed the effects of turbulence to be found: attenuation of pressure as a function of distance and extinction of interference zones. ESA

N88-24236# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
REFRACTION IN UNDERWATER ACOUSTICS Thesis [REFRACTIE IN DE ONDERWATER AKOESTIEK]
Jan vandenBerg Feb. 1987 61 p In DUTCH; ENGLISH summary
(B8735053; ETN-88-92471) Avail: NTIS HC A04/MF A01

Underwater acoustic refraction in a medium with a linear sound velocity profile was calculated. A method for the reduction of curved acoustic distances is described. Formulas for the reduction of electromagnetic waves in the atmosphere (Moritz, 1961) are applied with the Snellius law on underwater sound rays. The Moritz reduction formulas calculate directly the difference between the straight geometric distance and the curved acoustic distance by integration along the straight distance between start and endpoint. The reduction formulas were applied successfully in a mathematical model for the calculation of geometric coordinates from measured curved acoustic rays in a three transponder navigation system. Most of the formulas were tested in a program written in GW-BASIC on an IBM-compatible. ESA

N88-24237# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE CALCULATION OF CASUALLY CONSTRAINED OPTIMA IN THE ACTIVE CONTROL OF SOUND
P. A. Nelson, J. K. Hammond, P. Joseph, and S. J. Elliot Jan. 1988 60 p
(ISVR-TR-147; ETN-88-92502) Avail: NTIS HC A04/MF A01

The formal analytical basis for the calculation of casually constrained optima in problems of active sound control is introduced. It is shown that classical Wiener-Hopf techniques form the natural basis for such calculations, undertaken for signals in continuous time. The minimization of the mean squared acoustic pressure at a position in the field of a point monopole primary source by the introduction of a point monopole secondary source is considered. The primary source radiates a stationary random signal and the secondary source is constrained to act casually with respect to the primary source. In a second example, the secondary source is again constrained to act casually with respect to the primary source and the minimum acoustic power radiated by the source combination is calculated. The physical nature of acoustic propagation is shown to be directly responsible for the need to undertake an optimal prediction of the acoustic signal if destructive interference is to be achieved. Such a situation occurs whenever cancellation of sound is attempted at positions which are closer to the primary source of sound than the secondary source of sound introduced to control the field. ESA

N88-24238# Metraflu, Ecully (France).
INVESTIGATION OF INTENSITY AND PHASE FLUCTUATIONS OF AN ACOUSTIC WAVE AFTER CROSSING THERMAL TURBULENCE Final Report [ETUDE DES FLUCTUATIONS D'INTENSITE ET DE LA PHASE D'UNE ONDE ACOUSTIQUE APRES TRAVERSEE D'UNE TURBULENCE THERMIQUE]
Philippe Blanc-Benon, Daniel Juve, and Pierre Roland Nov. 1987 50 p In FRENCH
(Contract DRET-85-34-341-00-470-75-01)
(ETN-88-92542) Avail: NTIS HC A03/MF A01

An experimental facility to modify the characteristics of thermal turbulence was built for use in investigations of acoustic wave propagation. The first, second, and fourth moments of order of the transmitted acoustic wave were measured. Intensity fluctuations and their probability density were studied. A digital processing system for phase fluctuations was developed. The measurements were analyzed on the basis of the parabolic approximation and fast Fourier transformation of second order for any type of incident acoustic wave. ESA

N88-24239*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOURCES AND LEVELS OF BACKGROUND NOISE IN THE NASA AMES 40- BY 80-FOOT WIND TUNNEL Status Report
Paul T. Soderman May 1988 44 p
(NASA-TM-100077; A-88112; NAS 1.15:100077) Avail: NTIS HC A03/MF A01 CSCL 20A

Background noise levels are measured in the NASA Ames Research Center 40- by 80-Foot Wind Tunnel following installation of a sound-absorbent lining on the test-section walls. Results show that the fan-drive noise dominated the empty test-section background noise at airspeeds below 120 knots. Above 120 knots, the test-section broadband background noise was dominated by wind-induced dipole noise (except at lower harmonics of fan blade-passage tones) most likely generated at the microphone or microphone support strut. Third-octave band and narrow-band spectra are presented for several fan operating conditions and test-section airspeeds. The background noise levels can be reduced by making improvements to the microphone wind screen or support strut. Empirical equations are presented relating variations of fan noise with fan speed or blade-pitch angle. An empirical expression for typical fan noise spectra is also presented. Fan motor electric power consumption is related to the noise generation. Preliminary measurements of sound absorption by the test-section lining indicate that the 152 mm thick lining will adequately absorb test-section model noise at frequencies above 300 Hz. Author

N88-24240*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE EXACT CALCULATION OF QUADRUPOLE SOURCES FOR SOME INCOMPRESSIBLE FLOWS
Kenneth S. Brentner May 1988 11 p Presented at the Spring Conference: Acoustics 1988 in Cambridge, England, 5-8 Apr. 1988
(NASA-TM-100623; NAS 1.15:100623) Avail: NTIS HC A03/MF A01 CSCL 20A

This paper is concerned with the application of the acoustic analogy of Lighthill to the acoustic and aerodynamic problems associated with moving bodies. The Ffowcs Williams-Hawkings equation, which is an interpretation of the acoustic analogy for sound generation by moving bodies, manipulates the source terms into surface and volume sources. Quite often in practice the volume sources, or quadrupoles, are neglected for various reasons. Recently, Farassat, Long and others have attempted to use the FW-H equation with the quadrupole source and neglected to solve for the surface pressure on the body. The purpose of this paper is to examine the contribution of the quadrupole source to the acoustic pressure and body surface pressure for some problems for which the exact solution is known. The inviscid, incompressible, 2-D flow, calculated using the velocity potential, is used to calculate the individual contributions of the various surface and volume source terms in the FW-H equation. The relative importance of each of the sources is then assessed. Author

N88-24241* National Aeronautics and Space Administration. Pasadena Office, Calif.
SINGLE MODE LEVITATION AND TRANSLATION Patent
Martin B. Barmatz, inventor (to NASA) and James L. Allen, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 12 Apr. 1988 10 p Filed 18 Oct. 1985 Supersedes N86-20087 (24 - 10, p 1663) Continuation-in-part of US-Patent-4,573,356, US-Patent-Appl-SN-627537, dated 3 Jul. 1984
(NASA-Case-NPO-16675-1-CU; US-Patent-4,736,815; US-Patent-Appl-SN-789266; US-Patent-Class-181-0.5; US-Patent-Class-73-505; US-Patent-Class-367-191; US-Patent-Appl-SN-627537; US-Patent-4,573,356) Avail: US Patent and Trademark Office CSCL 20A

A single frequency resonance mode is applied by a transducer to acoustically levitate an object within a chamber. This process allows smooth movement of the object and suppression of unwanted levitation modes that would urge the object to a different

levitation position. A plunger forms one end of the chamber, and the frequency changes as the plunger moves. Acoustic energy is applied to opposite sides of the chamber, with the acoustic energy on opposite sides being substantially 180 degrees out of phase.
Official Gazette of the U.S. Patent and Trademark Office

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N88-24242*# Virginia State Univ., Petersburg. Solid State Physics Research Inst.
MATERIALS SCIENCE WITH MUON SPIN ROTATION Annual Report, 1 Mar. 1987 - 29 Feb. 1988
29 Feb. 1988 92 p
(Grant NAG1-416)
(NASA-CR-182891; NAS 1.26:182891) Avail: NTIS HC A05/MF A01 CSCL 20L

During this reporting period, the focus of activity in the Materials Science with Muon Spin Rotation (MSMSR) program was muon spin rotation studies of superconducting materials, in particular the high critical temperature and heavy-fermion materials. Apart from these studies, work was continued on the analysis of muon motion in metal hydrides. Results of these experiments are described in six papers included as appendices. For individual titles, see N88-24243 through N88-24248.

N88-24243*# Brookhaven National Lab., Upton, N. Y.
SYSTEMATIC VARIATION OF MAGNETIC-FIELD PENETRATION DEPTH IN HIGH-T(c) SUPERCONDUCTORS STUDIED BY MUON SPIN RELAXATION **c76**
Y. J. Uemura, V. J. Emery, A. R. Moodenbaugh, M. Suenaga, D. C. Johnston, A. J. Jacobson, J. T. Lewandowski, J. H. Brewer, R. F. Kiefl, and S. R. Kreitzman (Tri-Univ. Meson Facility, Vancouver, British Columbia) et al. *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 15 p Sponsored in part by the NSERC, Canada (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grant NSF DMR-85-03223)
Avail: NTIS HC A05/MF A01 CSCL 20L

The muon relaxation rate (sigma) was measured in the high critical temperature superconductors YBa2Cu3O(x) for x = 6.66, 6.95, 7.0, and La1.85 Sr0.15 CuO4 in transverse external magnetic fields 1 is approximately 4kG. A simple relation is found which connects the transition temperature T(c), the magnetic field penetration depth lambda(L), the carrier concentration n(s) and the effective mass m* as T(c) varies as sigma which varies as 1/lambda(L) squared which varies as n(s)/m*. The linear dependence T(c) varies as n(s)/m* suggests a high energy scale for the coupling between superconducting carriers. Author

N88-24244*# Brookhaven National Lab., Upton, N. Y.
COMPARISON BETWEEN MUON SPIN ROTATION AND NEUTRON SCATTERING STUDIES ON THE 3-DIMENSIONAL MAGNETIC ORDERING OF La2CuO(4-y) **c76**
Y. J. Uemura, W. J. Kossler, J. R. Kempton, X. H. Yu, H. E. Schone, D. Opie, C. E. Stronach, J. H. Brewer, R. F. Kiefl, and S. R. Kreitzman (Tri-Univ. Meson Facility, Vancouver, British Columbia) et al. *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 10 p Presented at the Interlaken HTSC-M2S Conference, Feb. 1988 Sponsored in part by NSERC, Canada and the Ministry of Education, Culture and Science, Japan (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grant NSF DMR-85-03223)
Avail: NTIS HC A05/MF A01 CSCL 20L

Muon spin rotation and neutron scattering studies on powder and single-crystal specimens of La2CuO(4-y) are compared. The apparent difference between the muon and neutron results for the ordered moment in the antiferromagnetic state is interpreted as the signature of increasingly short-ranged spatial spin correlations with increasing oxygen content. Author

N88-24245*# Brookhaven National Lab., Upton, N. Y.
COEXISTING STATIC MAGNETIC ORDERING AND SUPERCONDUCTIVITY IN CeCu2.1Si2 FOUND BY MUON SPIN RELAXATION **c76**
Y. J. Uemura, W. J. Kossler, X. H. Yu, H. E. Schone, J. R. Kempton, C. E. Stronach, S. Barth, F. N. Gygax, B. Hitti, and A. Schenck (Eidgenoessische Technische Hochschule, Zurich, Switzerland) et al. *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 14 p Sponsored in part by Ministry of Education, Science and Culture, Japan (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grants NSF DMR-85-03223; NSF INT-84-13978)
Avail: NTIS HC A05/MF A01 CSCL 20L

Zero- and longitudinal-field muon spin relaxation measurements on a heavy fermion system CeCu2.1 Si2 have revealed an onset of static magnetic ordering below T(M) approximately 0.8 K, which coexists with superconductivity below T(c) = 0.7 K. The line shapes of the observed muon spin depolarization functions suggest an ordering in either spin glass or incommensurate spin-density-wave state, with a small averaged static moment of the order of 0.1 micro-B per formula unit at T approaches 0. Author

N88-24246*# Brookhaven National Lab., Upton, N. Y.
STATIC MAGNETIC ORDERING OF CeCu2.1Si2 FOUND BY MUON SPIN RELAXATION **c76**
Y. J. Uemura, W. J. Kossler, X. H. Yu, H. E. Schone, J. R. Kempton, C. E. Stronach, S. Barth, F. N. Gygax, B. Hitti, and A. Schenck (Eidgenoessische Technische Hochschule, Zurich, Switzerland) et al. *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 7 p Presented at the Interlaken HTSC-M2S Meeting, Feb. 1988 Sponsored in part by Ministry of Education, Science and Culture, Japan (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grants NSF DMR-85-03223; NSF INT-84-13978)
Avail: NTIS HC A05/MF A01 CSCL 20L

Zero- and longitudinal-field muon spin relaxation measurements on a polycrystal sample of a heavy fermion superconductor CeCu2.1 Si2 (T(c) = 0.7 K) have revealed an onset of static magnetic ordering below T approximately 0.8 K. The line shapes of the observed spectra in zero field indicate a wide distribution of static random local fields at muon sites, suggesting that the ordering is either spin glass or incommensurate spin-density-wave state. The observed width of the random local field at T = 0.05 K corresponds to a small averaged static moment of the order of 0.1 micro-B per formula unit. Author

N88-24247*# College of William and Mary, Williamsburg, Va.
MUON MOTION IN TITANIUM HYDRIDE **c76**
J. R. Kempton, K. G. Petzinger, W. J. Kossler, H. E. Schone, B. S. Hitti, C. E. Stronach, N. Adu, W. F. Lankford, J. J. Reilly, and E. F. W. Seymour (Warwick Univ. Coventry, England) *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 22 p (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grant NSF DMR-85-03223)
Avail: NTIS HC A05/MF A01 CSCL 20L

Motional narrowing of the transverse-field muon spin rotation signal was observed in gamma-TiH(x) for x = 1.83, 1.97, and 1.99. An analysis of the data for TiH1.99 near room temperature indicates that the mechanism responsible for the motion of the muon out of the octahedral site is thermally activated diffusion with an attempt frequency comparable to the optical vibrations of the lattice. Monte Carlo calculations to simulate the effect of muon and proton motion upon the muon field-correlation time were used to interpret the motional narrowing in TiH1.97 near 500 K. The interpretation is dependent upon whether the Bloembergen, Purcell, and Pound (BPP) theory or an independent spin-pair relaxation model is used to obtain the vacancy jump rate from proton NMR T1 measurements. Use of BPP theory shows that the field-correction time can be obtained if the rate of motion of the muon with respect to the rate of the motion for the protons is

decreased. An independent spin-pair relaxation model indicates that the field-correlation time can be obtained if the rate of motion for the nearest-neighbor protons is decreased. Author

N88-24248*# Brookhaven National Lab., Upton, N. Y.
SEARCH FOR BOUND STATES OF THE ETA-MESON IN LIGHT NUCLEI **c76**
R. E. Chrien, S. Bart, P. Pile, R. Sutter, N. Tsoupas, H. O. Funsten, J. M. Finn, C. Lyndon, V. Punjabi, and C. F. Perdrisat (College of William and Mary, Williamsburg, Va.) et al. *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 13 p (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grant NSF PHY-85-09880-05)
Avail: NTIS HC A05/MF A01 CSCL 20L

A search for nuclear-bound states of the eta meson was carried out. Targets of lithium, carbon, oxygen, and aluminum were placed in a pion(+) beam at 800 MeV/c. A predicted eta bound state in O-15* (E sub x approx. = 540 MeV) with a width of approx. 9 MeV was not observed. A bound state of a size 1/3 of the predicted cross section would have been seen in this experiment at a confidence level of 3sigma (P is greater than 0.9987). Author

N88-24249# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
EXPERIMENTS ON REACTIONS OF THE ELECTRONICALLY EXCITED MOLECULE NITRON NH (a SUP 1 DELTA) AND CARBON CH2 (a BAR SUP 1 A(1)) IN GAS PHASE [UNTERSUCHUNG VON REAKTIONEN DER ELEKTRONISCH ANGEREGTEN MOLEKUELE NITREN NH (A SUP 1 DELTA) UND CARBEN CH2 (A BAR SUP 1 A(1)) IN DER GASPHASE]
A. Wilms Mar. 1987 159 p In GERMAN
(MPIS-3/1987; ISSN-0436-1199; ETN-88-91926) Avail: NTIS HC A08/MF A01; Max-Planck-Institut fuer Stroemungsforschung, Boettinger Strasse 6-8, 3400 Goettingen, Federal Republic of Germany 33 Deutsche marks

For the determination of gas phase reaction kinetics, reaction experiments of electronically excited NH and CH2 are described. The production of NH and CH2 is performed by laser-photolysis of HN3 and CH2CO. The reaction products are examined by laser induced fluorescence. During the reactions of NH with Xe, H2O, O2, CO2, N2, and N2O the primary by products of the radicals OH and NH are studied. For CH2 the reaction kinetics constants with H2O2, C2H2, C6H6, and H2O are established. This theoretical study is also of pratical interest to investigate the combustion of carbohydrate where CH2 is formed with other compounds of unsaturated chemical bonds contributing to rust phenomena. ESA

N88-24250# Grenoble-1 Univ. (France). Lab. de Physique Nucleaire.
SUBTHRESHOLD PION PRODUCTION IN PROTON INDUCED REACTIONS AT 180 TO 201 MeV AND He3 AT 283 MeV Ph.D. Thesis [PRODUCTION DES PIONS SOUS LE SEUIL DANS LES REACTIONS INDUITES PAR DES PROTONS DE 180 ET 201 MEV ET DES 3 HE DE 283 MEV]
Benedicte Million 1987 112 p In FRENCH; ENGLISH summary
(ETN-88-92303) Avail: NTIS HC A06/MF A01

Subthreshold-pion production in (p,pi + or -) reactions at 180 and 201 MeV and (He(3),pi + or -) reactions at 94 MeV/N is studied with several targets spanning the periodic table. Two analyzing systems were used: a magnetic spectrometer and a range telescope. The results are compared to those of (C(12),pi) at 85 MeV/N. The independent-nucleon model is applied to the reactions (p,pi), (He(3),pi), and (C(12),pi). Pion production is calculated as an incoherent sum of NN yields pi NN collisions where the momentum distribution of the target and projectile nucleons are taken into account. It is shown that this model, which is satisfying for high incident energies, cannot reproduce experimental results for incident energies lower than 300 MeV for the (p,pi) reaction and 180 MeV/N for (He(3),pi) and (C(12),pi) reactions. A qualitative estimate of the role of pion absorption in the target nucleus was made using a classical picture. ESA

N88-24251*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN EVALUATION OF ENERGY-INDEPENDENT HEAVY ION TRANSPORT COEFFICIENT APPROXIMATIONS
L. W. Townsend and J. W. Wilson [1988] 13 p
(NASA-TM-101158; NAS 1.15:101158) Avail: NTIS HC A03/MF A01 CSCL 20H

Utilizing a one-dimensional transport theory for heavy ion propagation, evaluations of typical energy-dependent transport coefficient approximations are made by comparing theoretical depth-dose predictions to published experimental values for incident 670 MeV/nucleon Ne-20 beams in water. Results are presented for cases where the input nuclear absorption cross sections, or input fragmentation parameters, or both, are fixed. The lack of fragment charge and mass concentration resulting from the use of Silberberg-Tsao fragmentation parameters continues to be the main source of disagreement between theory and experiment. Author

N88-24252*# Nebraska Univ., Lincoln. Physics Lab.
TOTAL PHOTOIONIZATION CROSS SECTIONS OF ATOMIC OXYGEN FROM THRESHOLD TO 44.3A
G. C. Angel and James A. R. Samson [1987] 31 p
(Grant NGR-28-004-021)
(NASA-CR-182992; NAS 1.26:182992) Avail: NTIS HC A03/MF A01 CSCL 20H

The relative cross section of atomic oxygen for the production of singly charged ions has been remeasured in more detail and extended to cover the wavelength range 44.3 to 910.5 A by the use of synchrotron radiation. In addition, the contribution of multiple ionization to the cross sections has been measured allowing total photoionization cross sections to be obtained below 250 A. The results have been made absolute by normalization to previously measured data. The use of synchrotron radiation has enabled measurements of the continuum cross section to be made between the numerous autoionizing resonances that occur near the ionization thresholds. This in turn has allowed a more critical comparison of the various theoretical estimates of the cross section to be made. The series of autoionizing resonances leading to the 4-P state of the oxygen ion have been observed for the first time in an ionization type experiment and their positions compared with both theory and previous photographic recordings. Author

N88-24253* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ION GENERATOR AND ION APPLICATION SYSTEM Patent
Alan P. Biddle, inventor (to NASA), Nobie H. Stone, inventor (to NASA), David L. Reasoner, inventor (to NASA), William L. Chisholm, inventor (to NASA), and John M. Reynolds, inventor (to NASA) 3 May 1988 8 p Filed 3 Mar. 1987 Supersedes N87-25829 (25 - 19, p 2657)
(NASA-Case-MFS-28122-1; US-Patent-4,742,232; US-Patent-Appl-SN-021100; US-Patent-Class-250-427; US-Patent-Class-250-423-R; US-Patent-Class-250-251; US-Patent-Class-315-111.41; US-Patent-Class-315-111.71; US-Patent-Class-315-111.81) Avail: US Patent and Trademark Office CSCL 20H

A vacuum chamber within which an instrument to be calibrated or tested is placed, is fitted with an ion gun having an ion source. The source has an electron emitting filament positioned adjacent to one end of an ionization chamber, with a negatively biased grid located behind the filament. Gas is injected into the source by a gas flow regulator in one end of the source. The chamber is surrounded by a plurality of independently energizable coils, with the last coil being operated at the highest current level, thus producing the highest magnetic flux. This presents a region of magnetic repulsion to the electrons produced by the filament and causes them to be confined between the grid and the region, greatly increasing the chances that an ionization collision will occur between the electrons and atoms of the injected gas. Ions are extracted from the ionization chamber by a negatively biased extractor grid positioned adjacent to an opposite end of the

chamber and are collimated by a negatively biased shield grid positioned adjacent to the extractor grid.
Official Gazette of the U.S. Patent and Trademark Office

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N88-24254# New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
TRANSACTIONS OF THE FOURTH SYMPOSIUM ON SPACE NUCLEAR POWER SYSTEMS
Mohamed S. El-Genk, ed. and Mark D. Hoover, ed. (Lovelace Inhalation Toxicology Research Inst., Albuquerque, N. Mex.) 1987 513 p Symposium held in Albuquerque, N. Mex., 12-16 Jan. 1987; co-sponsored by American Inst. of Chemical Engineers, ASTM, GE Co., LANL, Sandia National Labs., AFSTC, and American Nuclear Society
(DE88-006164; CONF-870102-Summs) Avail: NTIS HC A22/MF A01

The preceedings of the 4th Symposium on Space Nuclear Power Systems are presented. Research and progress on the SP-100 Space Power Reactor and Multimegawatt Space Nuclear Power Programs are detailed. The transactions are divided into several headings including: Future space station power options; Space nuclear missions and applications; Reactors and shielding; Nuclear electric and nuclear propulsion; Refractory alloys and high temperature materials; Testing; Reactors and Shielding II; Nuclear electric and nuclear propulsion II; Radioisotope power systems; Instrumentation and control; Energy conversion and storage; Radiation, thermal and environmental effects; Energy conversion and storage II; Space nulcear fuels; Thermal management; Energy conversion and storage III; Thermal management II; Multimegawatt system concepts; Simulation and modeling; and Nuclear safety For individual titles, see N88-24255 through N88-24373.

N88-24255*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OVERVIEW OF NASA LEWIS RESEARCH CENTER FREE-PISTON STIRLING ENGINE TECHNOLOGY ACTIVITIES APPLICABLE TO SPACE POWER SYSTEMS c44
Jack G. Slaby *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 1-6 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 10B

A brief overview is presented of the development and technological activities of the free-piston Stirling engine. The engine started as a small scale fractional horsepower engine which demonstrated basic engine operating principles and the advantages of being hermetically sealed, highly efficient, and simple. It eventually developed into the free piston Stirling engine driven heat pump, and then into the SP-100 Space Reactor Power Program from which came the Space Power Demonstrator Engine (SPDE). The SPDE successfully operated for over 300 hr and delivered 20 kW of PV power to an alternator plunger. The SPDE demonstrated that a dynamic power conversion system can, with proper design, be balanced; and the engine performed well with externally pumped hydrostatic gas bearings. E.R.

N88-24256*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BENEFITS OF 20 kHz PMAD IN A NUCLEAR SPACE STATION c33
Gale R. Sundberg *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 7-10 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 09C

Compared to existing systems, high frequency ac power provides higher efficiency, lower cost, and improved safety benefits. The 20 kHz power system has exceptional flexibility, is inherently user friendly, and is compatible with all types of energy sources; photovoltaic, solar dynamic, rotating machines and nuclear. A 25 kW, 20 kHz ac power distribution system testbed was recently (1986) developed. The testbed possesses maximum flexibility, versatility, and transparency to user technology while maintaining high efficiency, low mass, and reduced volume. Several aspects of the 20 kHz power management and distribution (PMAD) system that have particular benefits for a nuclear power Space Station are discussed. Author

N88-24257# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
OPERATIONAL CONCERNS INVOLVING A SHADOW-SHIELDED NUCLEAR REACTOR FOR SPACE STATION APPLICATIONS
E. B. Kennel and J. R. Welch (Space Power, Inc., San Jose, Calif.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 11-14 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

It is concluded that a shadow shielded reactor can be operated safely for a manned space station application providing it can be shut down during docking attempts and possibly certain EVA activities. A shadow shielded reactor carries an enormous weight advantage compared to a 4-pi shielded device, although the shadow shielded system will certainly introduce new complexities to thermal management during shutdown and restart. Ways in which the weight advantage can be exploited include increasing the power output of the reactor, carrying additional backup power or carrying additional cargo. Author

N88-24258*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPECULATIONS ON FUTURE OPPORTUNITIES TO EVOLVE BRAYTON POWERPLANTS ABOARD THE SPACE STATION c44
Robert E. English *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 15-18 Previously announced as N87-23674 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 10B

The Space Station provides a unique, low risk environment in which to evolve new capabilities. In this way, the Space Station will grow in capacity, in its range of capabilities, and its economy of operation as a laboratory and as a center for space operations. The Brayton cycle using a mixture of He and Xe as its working fluid is examined herein. Using a Brayton powerplant to supply the station's increasing demands for both electric power and heat has the potential to gradually evolve higher and higher performance by exploiting already evolved materials (Ta alloy and molten-Li heat storage), its peak cycle temperature rising ultimately to 1500 K. Adapting the station to exploit long tethers (200 to 300 km) could yield increases in payloads to LEO, to GEO, and to distant destinations in the solar system. Such tethering of the Space Station would not only require additional power for electric propulsion but also would so increase nuclear safety that nuclear powerplants might provide this power. From an 8000 kWt SP-100 reactor, thermoelectric power generation could produce 300 kWe, or adapted solar-Brayton cycle, 2400 to 2800 kWe. Author

N88-24259# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE RESULTS OF APPLICATION STUDIES FOR SPACE NUCLEAR POWER
L. Isenberg, K. McGraw, J. Mankins, J. Mondt, and J. Olivieri *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 19-21 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The results are summarized of the studies over the last several years to identify and characterize potential applications for the SP-100 space nuclear reactor power system in powering spacecraft.

SP-100 is a space power system based on a fast spectrum nuclear reactor with thermoelectric power conversion and liquid metal and heat pipe thermal transport. SP-100 reactor systems are designed to provide electric power with user designated characteristics at levels in the range from 10 to 1000 kWe. The use of nuclear reactors such as SP-100 as a power source provides a potential means of providing uninterrupted electrical power as required for many of todays space missions within acceptable cost and safety constraints. Author

N88-24260# RCA Astro-Electronics Div., Princeton, N. J.
PARAMETRIC ANALYSIS OF POWER REQUIREMENTS FOR SPACE-BASED RADAR **c33**
B. P. Miller, S. W. McCandless, and L. S. Dreifus *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 23-26 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Space based radar (SBR) has been suggested as a sensor for the detection, identification and discrimination of low observable targets on the surface of the Earth, within the atmosphere, and in space. An interactive simulation model was developed to facilitate performance tradeoff studies for SBR missions. The model is a parametric multimode preliminary design tool. It is resident on a microcomputer and enables the rapid generation of point designs allowing optimization of system cost and performance. The initial results from the study of space based radar mission requirements have revealed the relative imaturity of current technology, both in terms of performance and especially in terms of cost. E.R.

N88-24261*# General Electric Co., Philadelphia, Pa. Spacecraft Operation.
NUCLEAR ELECTRIC POWER FOR MULTIMEGAWATT ORBIT TRANSFER VEHICLES **c33**
R. D. Casagrande *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 27-30 Sponsored by NASA, Lewis Research Center, Cleveland, Ohio, AFOSR, Bolling AFB, Washington, D.C. and AFRPL, Edwards AFB, Calif. (For primary document see N88-24254 17-73)
(Contract F29601-86-C-0238)
Avail: NTIS HC A22/MF A01 CSCL 09C

Multimegawatt nuclear propulsion is an attractive option for orbit transfer vehicles. The masses of these platforms are expected to exceed the capability of a single launch from Earth necessitating assembly in space in a parking orbit. The OTV would transfer the platform from the parking orbit to the operational orbit and then return for the next mission. Electric propulsion is advantageous because of the high specific impulse achieved by the technology, 1000 to 5000 s and beyond, to reduce the propellant required. Nuclear power is attractive as the power system because of the weight savings over solar systems in the multimegawatt regime, and multimegawatts of power are required. A conceptual diagram is shown of an OTV with a command control module using electric thrusters powered from an SP-100 class nuclear reactor power system. Author

N88-24262# General Electric Co., Philadelphia, Pa. Space Systems Div.
SPACE BASED RADAR APPLICATION TO AIR TRAFFIC CONTROL **c04**
William J. Caime *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 31-33 (For primary document see N88-24254 17-73)
(Contract JPL-956969)
Avail: NTIS HC A22/MF A01

Space based radar offers an incomparable technique for broad area surveillance and rapid aircraft target detection and track. Directly derived, real time images can assist in achieving future goals for more effective control in an environment of increasing air traffic. Realization of the full capability of the technique will require continued development of high spacecraft power systems in excess of 100 kW as well as that for space radar subsystems. Optimization of the concept requires further analysis to consider spacecraft constellation and scan/dwell strategies to mitigate limitations such as coverage gaps in various traffic scenarios. Cooperating transponders will assist in dense traffic environments, and their application to SBR will have little impact on planned systems. Other improvements such as sophisticated tracking algorithms must be pursued. The integration and fusion of available SBR data with other planned improvements also must be addressed in a long term phased approach to future ATC, keyed to the availability of the emerging technologies. Author

N88-24263# Argonne National Lab., Ill. Applied Physics Div.
EFFECTS OF SPACE-DEPENDENT CROSS SECTIONS ON CORE PHYSICS PARAMETERS FOR COMPACT FAST SPECTRUM SPACE POWER REACTORS
R. M. Lell and N. A. Hanan *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 35-38 Previously announced as N87-30168 (For primary document see N88-24254 17-73)
(Contract W-31-109-eng-38)
Avail: NTIS HC A22/MF A01

Effects of multigroup neutron cross section generation procedures on core physics parameters for compact fast spectrum reactors were examined. Homogeneous and space dependent multigroup cross section set were generated in 11 and 27 groups for a representative fast reactor core. These cross sections were used to compute various reactor physics parameters for the reference core. Coarse group structure and neglect of space dependence in the generation procedure resulted in inaccurate computations of reactor flux and power distributions and in significant errors regarding estimates of core reactivity and control system worth. Delayed neutron fraction was insensitive to cross section treatment, and computed reactivity coefficients were only slightly sensitive. However, neutron lifetime was found to be very sensitive to cross section treatment. Deficiencies in multigroup cross sections are reflected in core nuclear design and, consequently, in system mechanical design. Author

N88-24264# Argonne National Lab., Ill. Applied Physics Div.
CONSIDERATIONS PERTINENT TO THE DOPPLER EFFECT FOR SPACE REACTORS
Richard N. Hwang *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 39-42 Previously announced as N87-23252 (For primary document see N88-24254 17-73)
(Contract W-31-109-eng-38)
Avail: NTIS HC A22/MF A01

Because of the potential importance of the Doppler effect to the safety considerations of compact fast spectrum reactors for space applications, extensive investigations were carried out. The magnitude of the Doppler reactivity of such reactors is estimated. And, some relevant questions concerning the fundamental nature of the problems are addressed. A generic space reactor design having features of current designs is examined. In R-Z geometry, the reactor consists of 3 core regions which are made of UN with various enrichments mixed in with a W/Re matrix and coolant channels filled with Li7 and surrounded by Mo vessel and BeO reflector along with external control drums made of B4C in the radial direction and accompanied by axial regions. The axial region above the core contains BeO with W/Re structure. The enrichment increases as a function of radius to provide an approximately constant power distribution in the core regions. Hence, the temperature distribution is also expected to be approximately constant in various core regions. The Doppler reactivities are given for various radial and axial regions. Author

N88-24265*# General Electric Co., Sunnyvale, Calif. Nuclear Systems Technology Operation.
MATERIAL TRADEOFFS TO MINIMIZE FLOODING REACTIVITY
R. Protsik, C. L. Cowan, M. Kangilaski, and S. Vaidyanathan *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 43-46 Sponsored by NASA, Washington, D.C., DOE, Washington, D.C. and DOD, Washington,

D.C. (For primary document see N88-24254 17-73)
(Contract JPL-956473)
Avail: NTIS HC A22/MF A01 CSCL 18I

In the GE 100 KWe SP-100 design, the array of fuel pins in the core was surrounded by a thin neutron barrier made of a mixture of Nb-1 percent Zr and 20 percent B4C. The purpose of this barrier was to prevent the return to the reactor of thermalized neutrons in the event of a reactor flooding accident. Neutronically, the barrier produced a reduction in k sub eff of 15 percent. However, a mixture of Nb-1 percent Zr and B4C is a development item and may not be possible to produce. Several alternatives to this design were investigated. These include the use of W-26 percent Re for the fuel barrier and the introduction of fuel pin ducts made of Ta-8 percent W-2 percent Hf, Hf-10 percent Nb or pure Re. The use of W-26 percent Re for the fuel barrier material in place of W, and the use of T111, Hf-10 percent Nb, or Re duct material in place of Nb-1 percent Zr or Nb-1 percent Zr-20 percent B4C were found to substantially decrease k sub eff in the flooding situation. The best choice neutronically for duct material is Hf-10 percent Nb, because of its small impact on the k sub eff of the normal core. Author

N88-24266# Brookhaven National Lab., Upton, N. Y.
THERMAL-HYDRAULIC CONSIDERATIONS FOR PARTICLE BED REACTORS
R. Benenati, K. J. Araj, and F. Horn *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 47-50 (For primary document see N88-24254 17-73)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC A22/MF A01

In the design of particle bed reactor (PBR) cores, consideration must be given to the gas coolant channels and their configuration. Neutronics analysis provides the relative volume fractions of the component materials, but these must be arranged in such a manner as to allow proper cooling of all components by the gas flow at relatively low pressure drops. The thermal hydraulic aspects of this problem are addressed. A description of the computer model used in the analysis of the steady state condition is also included. Blowdown tests on hot particle bed fuel elements were carried out and are described. Author

N88-24267# Brookhaven National Lab., Upton, N. Y.
PARTICLE BED REACTOR SCALING RELATIONSHIPS
G. Slovik, K. Araj, F. L. Horn, H. Ludewig, and R. Benenati *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 51-54 (For primary document see N88-24254 17-73)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC A22/MF A01

The Particle Bed Reactor (PBR) concept can be used in several applications both as part of a power generating system or as a direct propulsion unit. In order to carry out optimization studies of systems involving a PBR, it is necessary to know the variation of the critical mass with pertinent system parameters such as weight, size, power level and thrust level. A parametric study is presented for all the practical combinations of fuel and moderating material. The PBR is described, the practical combinations of materials and dimensions are discussed, and an example is presented. Author

N88-24268# Commissariat a l'Energie Atomique, Gif-sur-Yvette (France). Centre d'Etudes Nucleaires.
STATUS OF CEA DESIGN AND SIMULATION STUDIES OF A 200 KWe TURBOELECTRIC SPACE POWER SYSTEM **c20**
F. Carre, E. Proust, F. Gervaise, J. P. Schwartz, Z. Tilliette, and B. Vrillon *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 55-60 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

A reference 200 kWe turboelectric space generator, basically composed of a 1.1 MW fast neutron spectrum lithium cooled reactor, of four redundant Brayton loops and of a heat pipe radiator, was developed to support the preliminary feasibility and cost studies completed in mid 1986. A new study is examined which is devoted to sensitivity analyses to the reference design options and operating conditions, with a view to improving the initial concept; at the same time, limited experimental work is intended to be started in the technology areas, that have been identified as the most crucial for the reference generator. The updated design features of the reference 200 kWe turboelectric space generator studied in France is presented, along with some of the alternative options to be analyzed in the near future, concerning the reactor and the conversion system in particular. Also presented is the major conclusions of the simulation studies that were performed to analyzed the overall behavior of the reference generator, during the startup and the accidental transients. Author

N88-24269# Wisconsin Univ., Madison. Fusion Technology Inst.
MAGNET SHIELDING ANALYSIS FOR SOAR: A SPACE FUSION REACTOR **c75**
Laila A. El-Guebaly *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 61-63 Sponsored by the Grainger Foundation and the Department of the Airforce, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The neutronics performance of alternate magnet shields was evaluated for the central cell of Space Orbiting Advanced Fusion Reactor (SOAR). The LiH shield appears to be the best from the neutronics standpoint. However, the selection of the shield type should be based on the neutronics performance as well as other considerations including the thermal and stress limitations. The passively cooled shield is an attractive design and the ease of incorporating the different shield options in such a design will be a major consideration for the sheild material choice. Author

N88-24270# Los Alamos National Lab., N. Mex.
HISTORY OF SOME DIRECT NUCLEAR PROPULSION DEVELOPMENTS SINCE 1946 **c20**
Richard J. Bohl, Jay E. Boudreau, and William L. Kirk *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 65-68 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

A brief history is presented of some direct nuclear propulsion development since 1946. Reasons are given for the use of direct nuclear propulsion. The ROVER project and the NERVA concept are summarized. E.R.

N88-24271# Air Force Rocket Propulsion Lab., Edwards AFB, Calif. Applications Analysis Branch.
DIRECT NUCLEAR PROPULSION FOR EARTH-TO-ORBIT VEHICLES **c20**
David R. Perkins *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 69-72 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

There is an ongoing study to identify a next generation space transportation system that achieves a goal of an order magnitude reduction in the cost of launching payloads into orbit. The current cost of launching payloads is very high due to existing launch system complexity, current system limitations in both launch rate capability and recurring hardware costs, and the large standing Army required to achieve launches. The cost of launching payloads is raised to ever higher levels when reliability against catastrophic failure is considered. Direct nuclear propulsion using very high power density particle bed reactor technology offers a practical approach to achieving these goals. The technology base to support such a vehicle is well defined. Most technical issues appear to have low risk solutions or backup approaches. The most difficult hurdle that a nuclear powered vehicle must overcome is not that of technical risk, but rather a political and public misconception concerning those risks. Author

N88-24272# Brookhaven National Lab., Upton, N. Y. Dept. of Nuclear Energy.
NUCLEAR PROPULSION SYSTEMS FOR ORBIT TRANSFER BASED ON THE PARTICLE BED REACTOR **c20**
J. R. Powell, H. Ludewig, F. L. Horn, K. Araj, R. Benenati, O. Lazareth, G. Slovik, M. Solon, W. Tappe, and J. Belisle (Grumman Aerospace Corp., Bethpage, N.Y.) et al. *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 73-76 Previously announced as N87-28405 Sponsored by AFRPL, Edwards AFB, Calif. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The technology of nuclear direct propulsion orbit transfer systems based on the Particle Bed Reactor (PBR) is described. A 200 megawatt illustrative design is presented for LEO to GEO and other high V missions. The PBR-OTV can be used in a one-way mode with the shuttle or an expandable launch vehicle, e.g., the Titan 34D7, or as a two-way reusable space tug. In the one-way mode, payload capacity is almost three times greater than that of chemical OTV's. PBR technology statis is described and development needs outlined. E.R.

N88-24273*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
INTERPLANETARY PROPULSION USING INERTIAL FUSION **c20**
Charles D. Orth, Nate Hoffman, Kathy Murray, Gail Klein (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), and Franklin Chang Diaz *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 77-80 Previously announced as N88-12540 (For primary document see N88-24254 17-73)
(Contract W-7405-eng-38)
Avail: NTIS HC A22/MF A01 CSCL 21H

Inertial fusion can be used to power spacecraft within the solar system and beyond. Such spacecraft have the potential for short duration manned mission performance exceeding other technologies. A study was conducted to assess the systems aspects of inertial as applied to such missions, based on the conceptual engine design of Hyde (1983). The required systems for an entirely new spacecraft design called VISTA that is based on the use of DT fuel is described. Preliminary design details are given for the power conversion and power conditioning systems for manned missions to Mars of total duration of about 100 days. E.R.

N88-24274*# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
A FUSION BASED PLASMA PROPULSION SYSTEM **c20**
J. A. George, B. Anderson, D. Bryant, C. Creese, V. Djordjevic, and K. L. Peddicord *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 81-84 Sponsored by NASA, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 21H

The Fusion Plasma Propulsion System scoping study was performed to investigate the possibilities of a fusion powered plasma propulsion system for space applications. Specifically, it was to be compared against existing electric propulsion concepts for a manned Mars mission. Design parameters consist of 1000 N thrust for 500 days, and the minimum mass possible. This investigation is briefly presented and conclusions drawn. Author

N88-24275# Brookhaven National Lab., Upton, N. Y.
ULTRA HIGH TEMPERATURE DIRECT PROPULSION **c20**
K. J. Araj, G. Slovik, J. R. Powell, and H. Ludewig *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 85-88 Previously announced as N87-27718 Sponsored by AFRPL, Edwards AFB, Calif. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Potential advantages of ultrahigh exhaust temperature (3000 to 4000 K) direct propulsion nuclear rockets are explored. Modifications to the Particle Bed Reactor (PBR) to achieve these temperatures are described. Benefits of ultrahigh temperature are discussed for two missions: orbit transfer (V = 5546 m/s) and interplanetary exploration (V = 20000 m/s). For such missions ultrahigh temperatures appear to be worth the additional complexity. Thrust levels are reduced substantially for a given power level, due to the higher enthalpy caused by partial disassociation of the hydrogen propellant. Though technically challenging, it appears potentially feasible to achieve such ultrahigh temperature using the PBR. E.R.

N88-24276# Science Applications International Corp., Albuquerque, N. Mex.
SAFETY CONSTRAINTS AND CONSIDERATIONS IN THE DEVELOPMENT OF NUCLEAR POWERED PROPULSION **c20**
David Buden *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 89-91 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The basic classes of missions that might use nuclear power, whether as a power source for electric propulsion or as direct nuclear propulsion, can be thought of in terms of orbital or planetary transfer, launch vehicle upper stage, and single stage to orbit vehicle. The basic premise in the development of nuclear power systems for any of these applications is that safety of the design is a prime consideration. The policy of the U.S. for all U.S. nuclear power sources in space is to ensure that the probability of release of radioactive material and the amount of release are such that an undue risk is not presented, considering the benefits of the mission. The safety issues of nuclear propulsion are specifically addressed to assure appropriate consideration of desirable safety features in the design. Author

N88-24277# Idaho National Engineering Lab., Idaho Falls.
REQUIREMENTS AND COST CONSIDERATIONS FOR A COMBINED SPACE NUCLEAR REACTOR TEST FACILITY
E. A. Harvego, D. L. Parks, J. H. Ramsthaler, W. C. Reed, J. F. Whitbeck, and B. B. Gillies (Rockwell International Corp., Canoga Park, Calif.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 93-96 (For primary document see N88-24254 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A22/MF A01

A first attempt is made to define and quantify facility requirements and potential cost savings associated with a combined facility operation which shares common support systems. The cost benefits are realized through sharing of existing facilities, and operations and support personnel by two or more space reactor testing programs. Using the INEL labor force as an example, potential savings of 15 to 40 percent in operating costs can be realized by the sharing of operations and support personnel among two or more programs. While savings of up to 28 percent in construction costs are possible by sharing common support facilities, it should be recognized that the two major cost items (hot cells and heat rejection systems) may be available at several DOE sites for refurbishment at considerable less than the cost for new construction. Author

N88-24278# Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy Lab.
THE ROLE OF OXYGEN ON THE MECHANICAL BEHAVIOR OF MOLYBDENUM ALLOYS **c26**
J. Wadsworth, T. G. Nieh, W. C. Coons, and J. J. Stephens (Sandia National Labs., Albuquerque, N. Mex.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 97-101 (For primary document see N88-24254 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A22/MF A01

The Group VI metals such as molybdenum, tungsten, and chromium are particularly susceptible to embrittlement by oxygen. A review is presented of the influence of O2 on the microstructure and mechanical properties of molybdenum and its alloys. The

deleterious effects of oxygen in high oxygen containing molybdenum alloys is shown. In these cases, oxgyen segregation to grain boundaries in molybdenum was manifested by speckling in optical photomicrographs. Such speckling was synonymous with poor ductility and toughness. Author

N88-24279*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY STUDY OF NIOBIUM ALLOY CONTAMINATION BY TRANSPORT THROUGH HELIUM **c26**
C. M. Scheuermann, T. J. Moore, and D. R. Wheeler *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 103-106 Sponsored by DOE, Washington, D.C. and DOD, Washington, D. C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 11F

Transport of gaseous contaminants through the working fluid to or from sensitive refractory alloys is theoretically possible during long time operation of Brayton and Stirling space power generation systems which use a gas as the working fluid. A test was designed which could give an answer to whether transport of contaminants through the working fluid was a potential major problem. The findings of that preliminary study are summarized. Author

N88-24280# Los Alamos National Lab., N. Mex.
IRRADIATION TEST RESULTS ON THERMIONIC FUEL ELEMENT SHEATH INSULATORS
W. A. Ranken and A. R. Veca (General Atomics Technologies Corp., San Diego, Calif.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 107-110 Sponsored by DOE, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Because the in-core thermionic reactor fuel element (TFE) serves not only as a fission energy heat source but also converts this heat directly to electricity in the reactor core itself, it poses a problem in materials utilization; the need for high temperature, radiation resistant electrical insulation. The challenge of sheath insulator design arises from the fact that it must withstand high fast neutron fluences while operating at about 1100 K with an impressed electric field on the order of 500 to 2500 V/cm. The ceramic component of the sheath insulator assembly must maintain high electrical resistivity under these conditions. After testing, it was concluded that yttria, alumina/niobium cermet, lanthana and praseodymia-loaded alumina, and possibly graded alumina could be useful for sheath insulator construction for the 100 kWe design, seven year lifetime thermionic reactor, particularly if end stress relief measures were taken to control end cracking in the alumina based sheath insulator assemblies. The results of a electrical stability test indicate that no short term irradiation effects operate to limit the insulation effectiveness of yttria or alumina sheath insulators for voltages up to 10 V. Author

N88-24281# Oak Ridge National Lab., Tenn.
HIGH-TEMPERATURE THERMAL CONDUCTIVITY OF A CARBON-BONDED CARBON-FIBER INSULATION **c27**
R. E. Pawel, W. P. Eatherly, J. M. Robbins, and D. L. McElroy *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 111-114 Previously announced as N87-18621 (For primary document see N88-24254 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A22/MF A01

The thermal conductivity of fibrous materials such as carbon bonded carbon fiber involves temperature dependent contributions from both the solid and gaseous constituents. At higher temperatures, radiative heat transfer also becomes important. Each of these contributions depends not only upon the volume fraction of the solid component, but will vary according to the morphological details. Steady state techniques have provided accurate measurements to 1400 K, and these results can be used for purposes of comparison and to test heat flow models. E.R.

N88-24282# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
FABRICATION OF LITHIUM HYDRIDE SHIELDS FOR SPACE NUCLEAR POWER SYSTEMS **c18**
Richard L. Gay *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 115-118 (For primary document see N88-24254 17-73)
(Contract AT(11-1)-GEN-8)
Avail: NTIS HC A22/MF A01

An operating space nuclear reactor as used in the SP-100 and the multimegawatt space power designs produces neutrons and gamma rays which may have a detrimental effect on satellite materials operating in the shadow of the reactor. In order to protect the satellite components, a shield is necessary between the reactor and the satellite. Elements with high atomic number are effective in attenuating gamma rays; elements with low atomic number are effective in attenuating neutrons. The fabrication of lithium hydride shields for neutron absorption is described. The technology for casting large, uniform LiH shields was developed and was demonstrated. This LiH casting facility is the most cost effective and lowest risk alternative for fabricating the neutron shields for the SP-100 and multimegawatt space reactor programs. Author

N88-24283# Oak Ridge Y-12 Plant, Tenn.
FABRICATION OF REACTOR SHIELDS AT THE Y-12 PLANT
W. L. Asbury, F. E. Kosinski, and L. T. Royer *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 119-120 (For primary document see N88-24254 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A22/MF A01

The Oak Ridge Y-12 Plant is the lead DOE facility for the large scale synthesis, manufacture, and fabrication of lithium hydride/deuteride (LiH/D) materials. Fabrication of large crack free LiH/D parts of uniform density and strength is best achieved by isostatic pressing, using powder metallurgy methods. The highly reactive and moisture sensitive nature of LiH/D has required a number of unique facilities and processing methods at Y-12 to process LiH/D in a safe manner and to maintain high quality products. The history of the fabrication of neutron shields for the SNAP 10A reactor is discussed. Powder metallurgical techniques were used to fabricate that shielding system at Y-12, and the units were tested for shielding efficiency at the Tower Shielding Facility at ORNL. Author

N88-24284# Hanford Engineering Development Lab., Richland, Wash.
CONCEPTUAL DESIGN OF THE SP-100 GES TEST SITE **c14**
W. C. Miller, J. L. Ethridge, P. J. Brackenbury, W. F. Carlson, P. A. Edwards, J. J. Irwin, E. J. Renkey, and E. J. Shen *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 121-124 (For primary document see N88-24254 17-73)
(Contract DE-AC06-76FF-02170)
Avail: NTIS HC A22/MF A01

Conceptual design is currently proceeding at the SP-100 Ground Engineering System Test Site. The test site project team is modifying an existing reactor facility to accommodate ground testing of a prototype SP-100 nuclear reactor subsystem in a simulated space environment. The 8 MWt, high temperature lithium cooled reactor will be operated inside a large vacuum test chamber. The ground test of the SP-100 nuclear assembly, which is composed of the reactor, a flight shield, and elements of the primary heat transport system, will verify its performance in as nearly prototypic conditions as possible. Design of the Test Site facilities and systems to test this unique, compact reactor safely and reliably, without altering its prototypic characteristics, presents several engineering challenges. These challenges and the designs to meet them are presented. Author

N88-24285# Westinghouse Hanford Co., Richland, Wash.
SELECTION OF A HANDLING AND MAINTENANCE OPTION FOR THE SP-100 GROUND ENGINEERING SYSTEM TEST

E. J. Shen, L. J. Schweiger, W. C. Miller, R. Gluck, and S. M. Davies (General Electric Co., Sunnyvale, Calif.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 125-129 (For primary document see N88-24254 17-73)
(Contract DE-AC06-76FF-02170)
Avail: NTIS HC A22/MF A01

In the fall of 1990, a flight prototypic SP-100 reactor, control system, and flight shield will be tested in a simulated space environment. The reactor, shield and primary liquid metal heat transport system form the module known as the Test Article (TA) which will be tested. A discussion is presented on the development of a TA Handling System which will support the installation, maintenance, and disassembly of the TA. Author

N88-24286# Argonne National Lab., Idaho Falls, Idaho.
FAST CRITICAL EXPERIMENT DATA FOR SPACE REACTORS
P. J. Collins, H. F. McFarlane, D. N. Olsen, C. A. Atkinson, and J. R. Ross *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 131-134 Previously announced as N88-10605 (For primary document see N88-24254 17-73)
(Contract W-31-109-eng-38)
Avail: NTIS HC A22/MF A01

Data from a number of previous critical experiments exist that are relevant to the design concepts being considered for SP-100 and MMW space reactors. Although substantial improvements in experiment techniques have since made some of the measured quantities somewhat suspect, the basic criticality data are still useful in most cases. However, experiments require recalculation with modern computational methods and nuclear cross section data before they can be applied to today's designs. Recently, about 20 fast benchmark critical experiments were calculated with the latest ENDF/B data and modern transport codes. These calculations were undertaken as a part of the planning process for a new series of benchmark experiments aimed at supporting preliminary designs of SP-100 and MMW space reactors. E.R.

N88-24287# Idaho National Engineering Lab., Idaho Falls.
AMMONIA CLEANUP OF LITHIUM CONTAINING COMPONENTS
D. L. Crandall, D. J. Marts, T. R. Reed, and G. R. Smolik *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 135-137 (For primary document see N88-24254 17-73)
(Contract DE-AO07-76ID-01570)
Avail: NTIS HC A22/MF A01

Following testing, lithium wetted refractory components will normally be drained of their lithium coolant prior to reuse or post-test inspection. However, experience has shown that the lithium cannot be completely removed from the refractory metal surfaces by draining alone. Prior experience has demonstrated that liquid anhydrous ammonia is an effective lithium cleaning agent in applications where it can be assured that the ammonia will remain in a liquid state. However, if ammonia is to be used to clean unrefrigerated components, some ammonia vapor is expected. Ammonia vapor can react with lithium to produce hydrogen which in turn may damage the refractory surfaces. Experiments are reported which were performed at the Idaho National Engineering Lab. These experiments explored the possibility of using liquid anhydrous ammonia to clean without damage unrefrigerated lithium wetted refractory components. Author

N88-24288# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
FULLY PASSIVE SPACE REACTOR CONCEPTUAL DESIGN
William F. Lyon, III, R. O. Montgomery, J. K. Thomas, and K. L. Peddicord *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 139-142 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

A study was undertaken to develop a fully passive, highly reliable, space reactor system (FPSR) capable of delivering 100 kWe over a ten year lifetime. The conceptual design phase is summarized, and anticipated work on the FPSR project is outlined. The major components of the FPSR design are the reactor core, the heat pipe array and the heat rejection panels. A review of the current reactor core, fuel material, power and reactivity control, heat removal and energy conversion systems is presented. Author

N88-24289# Missouri Univ., Columbia. Dept. of Nuclear Engineering.
SPACE BASED NUCLEAR-PUMPED LASER/REACTOR CONCEPTS c36
Guoxiang Gu, Mark A. Prelas, and Jay F. Kunze *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 143-147 (For primary document see N88-24254 17-73)
(Grant NSF CBT-83-52345)
Avail: NTIS HC A22/MF A01

Nuclear pumped lasers, which use charged particles from nuclear fission to pump a laser medium, is a concept for the direct use of nuclear fission energy. It is a process for driving lasers without generated electricity so that the efficiency is increased and the system simplified. The design of the nuclear reactor driver system and the laser is considered. Reactor computer codes, such as DISNL, XSDRN, PARET or IREKIN, and AMPX are used for calculations. The possibility and feasibility of surface, volume and aerosol ion sources for high power/energy nuclear pumped laser/reactor concepts are discussed from a neutronics perspective. Author

N88-24290# Florida Univ., Gainesville.
ACOUSTICAL GAS CORE REACTOR WITH MHD POWER GENERATION FOR BURST POWER IN A BIMODAL SYSTEM
E. T. Dugan, A. M. Jacobs, C. C. Oliver, and W. E. Lear, Jr. *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 149-152 Sponsored in part by the Frederick A. Hauck Fund and the Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Research is being conducted on gas core reactors for space nuclear power to establish the scientific feasibility and engineering validation of a reactor and energy conversion system that can significantly improve specific power, dynamic performance and system efficiency. Rapid achievement of burst mode (GWe) operation at core power densities of 1 kW/mL and reactor masses of a kg/MWt are research objectives; coupled with MHD conversion, system efficiencies of 40 percent for open cycle operation and heat rejection temperatures of 1500 K or higher for closed cycle operation are anticipated. The design of the gas core reactor/MHD generator configuration to directly produce pulsed electrical power, thereby alleviating external power conditioning requirements, is also a research objective. Author

N88-24291# California State Univ., Long Beach. Innovative Nuclear Space Power Inst.
FLUID DYNAMICS OF SPHERICAL CAVITY REACTORS
J. Richard Williams, Isaac Maya, Mohammed Dagher, Thomas Kim, and Craig Christy *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 153-155 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The development of compact nuclear space power supplies capable of reliably delivering multihundred megawatt or gigawatt levels of electric power are studied. The plasma core reactor combined with MHD generator appears to offer considerable promise for meeting this objective. The basic concept is a plasma core reactor consisting of a spherical cavity contained within a moderating region into which a region of fissile gas is injected. A surrounding flow of particle seeded inert gas serves to confine the fissioning plasma toward the central region of the cavity while

the inert gas is heated by radiation and convection from the uranium plasma. Air serves as the working fluid for both the central region and the surrounding region. Author

N88-24292# Cincinnati Univ., Ohio. Dept. of Physics.
BIFOLD: A DUAL-MODE NUCLEAR SPACE POWER SYSTEM **c20**

Warren Fenton Stubbins *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 157-160 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

With Pu-238 as its dominate fuel, the BIFOLD nuclear power source's quiescent base power from radioactive decay is augmented during periods of high demand by operation as a fast reactor. The BIFOLD concept unites reactor technology with radioactive thermal generator technology and provides several distinct advantages. These include demand power capability, freedom from auxiliary power sources and energy storage elements, the possibility of premission operation and testing of all components without the introduction of extraneous power, the inherent prevention of slow neutron criticality, freedom from reactor and component startup uncertainties, and a minimum base power for mission survival. Author

N88-24293# Oak Ridge National Lab., Tenn.
THE ROLE OF INTEGRAL EXPERIMENTS AND NUCLEAR CROSS SECTION EVALUATIONS IN SPACE NUCLEAR REACTOR DESIGN

David L. Moses and Richard D. McKnight (Argonne National Lab., Ill.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 161-166 Previously announced as N87-28404 Sponsored by DOE, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The importance of the nuclear and neutronic properties of candidate space reactor materials to the design process has been acknowledged as has been the use of benchmark reactor physics experiments to verify and qualify analytical tools used in design, safety, and performance evaluation. Since June 1966, the Cross Section Evaluation Working Group (CSEWG) has acted as an interagency forum for the assessment and evaluation of nuclear reaction data used in the nuclear design process. CSEWG data testing has involved the specification and calculation of benchmark experiments which are used widely for commercial reactor design and safety analysis. These benchmark experiments preceded the issuance of the industry standards for acceptance, but the benchmarks exceed the minimum acceptance criteria for such data. Thus, a starting place has been provided in assuring the accuracy and uncertainty of nuclear data important to space reactor applications. E.R.

N88-24294*# Princeton Univ., N. J. Electric Propulsion Lab.
MEGAWATT LEVEL ELECTRIC PROPULSION PERSPECTIVES **c20**

Robert G. Jahn and Arnold J. Kelly *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 167-171 (For primary document see N88-24254 17-73)
(Contracts JPL-954997; F04611-85-C-004)
Avail: NTIS HC A22/MF A01 CSCL 21H

For long range space missions, deliverable payload fraction is an inverse exponential function of the propellant exhaust velocity or specific impulse of the propulsion system. The exhaust velocity of chemical systems are limited by their combustion chemistry and heat transfer to a few km/s. Nuclear rockets may achieve double this range, but are still heat transfer limited and ponderous to develop. Various electric propulsion systems can achieve exhaust velocities in the 10 km/s range, at considerably lower thrust densities, but require an external electrical power source. A general overview is provided of the currently available electric propulsion systems from the perspective of their characteristics as a terminal load for space nuclear systems. A summary of the available electric propulsion options is shown and generally characterized in the power vs. exhaust velocity plot. There are 3 general classes of electric thruster devices: neutral gas heaters, plasma devices, and space charge limited electrostatic or ion thrusters. Author

N88-24295*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH POWER ION THRUSTER PERFORMANCE **c20**

Vincent K. Rawlin and Michael J. Patterson *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 173-176 Previously announced as N88-12542 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 21H

The ion thruster is one of several forms of space electric propulsion being considered for use on future SP-100 based missions. One possible major mission ground rule is the use of single Space Shuttle launch. Thus, the mass in orbit at the reactor activation altitude would be limited by the Shuttle mass constraints. When the spacecraft subsystem masses are subtracted from this available mass limit, a maximum propellant mass may be calculated. Knowing the characteristics of each type of electric thruster allow maximum values of total impulse, mission velocity increment, and thrusting time to be calculated. Because ion thrusters easily operate at high values of efficiency (60 to 70 percent) and specific impulse (3000 to 5000 sec), they can impart large values of total impulse to a spacecraft. They also can be operated with separate control of the propellant flow rate and exhaust velocity. Values are presented of demonstrated and projected performance of high power ion thrusters used in an analysis of electric propulsion for an SP-100 based mission. Author

N88-24296*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRIC PROPULSION OPTIONS FOR THE SP-100 REFERENCE MISSION **c20**

Terry L. Hardy, Vincent K. Rawlin, and Michael J. Patterson *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 177-180 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 21H

A study was conducted to compare resistojet, arcjet and ion thruster systems for use as an active load on a flight demonstration of the SP-100 nuclear power system. The dry masses of each propulsion system were calculated and assessments were made of the mission capabilities of each system based on the capabilities of a single Shuttle launch. From the analyses it was found that, for most systems, the dry mass accounted for less than 20 percent of the total propulsion system mass. The maximum velocity increments of the systems were up to 2300 m/s for resistojet, 4500 m/s for arcjet, and 24000 m/s for ion. The maximum thrusting times were up to 16 days for resistojet, 53 days for arcjet, and 853 days for ion thruster systems. Author

N88-24297*# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
A CRITIQUE OF NERVA BASED NUCLEAR REACTOR DESIGN AND PERFORMANCE FOR MMW SPACE PROPULSION APPLICATIONS **c20**

R. R. Holman *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 181-183 Sponsored by NASA, Washington, D.C. and AEC, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 21H

Some comparison data are provided for assessing benefits of solid core gas cooled nuclear reactors based on the Nuclear Engine for Rocket Vehicle Application (NERVA) for potential space propulsion systems. An assessment is presented of space nuclear reactor technology derived from the NERVA/ROVER programs of the 60's which can provide benefits for space power in its developed propulsion role. The engine dimensional envelope and system mass associated with the desired performance was defined to enable reasonable mission studies. The feasibility is indicated of a 15000 lb thrust size engine to perform competively in orbital

transfer missions and of providing payloads over 5000 kg to Saturn with less than 1 hr operation. It was also determined that such a reactor is well within NERVA technology and could be developed with a high degree of confidence. Author

N88-24298# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
NUCLEAR ELECTRIC PROPULSION SYSTEM: NUCLEAR PLANT AND THERMOMECHANICAL CONVERSION SYSTEM **c20**
Dion J. Sunderland and K. L. Peddicord *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 185-189 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The 2 loop nuclear power plant was designed for a manned mission to Mars of about 500 days at a constant thrust of 1000 n. In order to achieve a relatively low initial fuel mass, a high specific impulse was desired; consequently, a high power was required. After some analysis, a core power of 319 MW was chosen, and a subsequent electrical power of 90.1 MW was achieved assuming the component efficiencies given. A specific impulse of approx. 17000 s was obtained, using lithium as a propellant. The thruster was assumed to be a contact ion potential type. The propulsion system was not fully optimized due to a lack of information at the time that the design was undertaken. Further work is being conducted with regard to the feasibility of homopolar generators and the possibility of using radial (Ljungstrom) turbines, as opposed to the conventional axial flow turbines that were assumed to be used in the initial design. Author

N88-24299# Los Alamos National Lab., N. Mex.
THE LIGHT-WEIGHT RADIOISOTOPE HEATER UNIT (LWRHU): DEVELOPMENT AND APPLICATION
T. G. George, R. E. Tate, and T. A. Cull *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 191-196 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Radioisotope power sources have a long history of use in the American space program, both as components of radioisotope thermoelectric generators (RTGs), and as stand alone thermal power units. The primary goal of the LWRHU program was to develop a compact, second generation heat source that would offer improved performance and safety over previous radioisotope power units. The design objective fell into two categories: those relating to performance, such as thermal power, mass, lifetime, neutron emission, surface temperature, and thermodynamic stability; and those requirements related to safety, such as impact resistance, temperature resistance, corrosion resistance, and ablation control. The LWRHU program resulted in the design, development, and production of an improved, compact heat source suited for use in a variety of space missions. On the basis of the data generated during performance and safety verification testing, 100 LWRHUs were installed on the Galileo spacecraft. The extensive body of test data also makes the LWRHU a candidate for use in future civilian and military space missions. Author

N88-24300# General Electric Co., Philadelphia, Pa.
MHW RTG PERFORMANCE DURING LES 8/9 AND VOYAGER MISSIONS
C. E. Kelly *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 197-200 (For primary document see N88-24254 17-73)
(Contracts AT(29-2)-2831; EX-76-C-16-3066)
Avail: NTIS HC A22/MF A01

The MHW RTG is an isotope (plutonium 238) fueled static power supply operating on the thermoelectric energy conversion principle using silicon-germanium (SiGe) semiconductors. It provides a nomimal electrical power output of 150 watts with a thermal inventory of 2400 watts at BOM (beginning of mission) and was designed for a minimum of 5 years of space operation. BOM specific power is 4.2 W kg with an overall envelope of 40 cm x 58 cm. A description of the RTGs and the mission power profiles are described. The major components of the RTG are the heat source (IHS), RCA silicon-germanium thermoelectric couples (thermopile), a multifoil thermal insulation system and a beryllium outer housing. Author

N88-24301# Fairchild Space and Electronics Co., Germantown, Md.
PIONEER 10 AND 11 RTG PERFORMANCE UPDATE
E. A. Skrabek and John W. McGrew (Teledyne Energy Systems, Timonium, Md.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 201-204 Sponsored by DOE, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The long term reliability of radioisotope thermoelectric generators (RTGs) has been amply demonstrated by the Pioneer 10 and 11 spacecraft. Each spacecraft is powered by 4 SNAP-19 RTGs. The generators were fueled over 15 years ago (1971). The SNAP-19/Pioneer RTGs are made up to 3 major subsystems: the heat source, the thermopile and the housing and radiator. The heat source consists of a radioisotope fuel, plutonium 238, contained in a multilayer capsule, which is supported by Zr rings in a graphite heat shield. The thermoelectric converter consists of 6 modules, each of which bears upon a flat face of the heat shield. The exemplary performance of these spacecraft under demanding thermal and radiation exposure conditions has proven the reliability, adaptability, and efficiency of the SNAP-19 generator design. Author

N88-24302# Garrett Fluid Systems Co., Tempe, Ariz.
FOIL GAS BEARING SYSTEM ENDURANCE TESTING DYNAMIC ISOTOPE POWER SYSTEM **c37**
Keith A. Davis and John F. Ruggles *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 205-208 Sponsored by the Department of the Air Force, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Garrett Fluid Systems Co. (GFSC) conducted a test program which initiated a statistical data base for long term, closed cycle endurance foil bearing operation. The testing was conducted on multiple rotors supported by foil gas bearings and operating under closely simulated Dynamic Isotope Power System (DIPS) space power conditions of speed, gas, pressure, temperature, and Reynolds number. The test program provided a timely and economic means of demonstrating the endurance and reliability of the foil gas bearing concept. A review is presented of the system, the test program, and progress made to this date. Author

N88-24303# Sundstrand Corp., Rockford, Ill.
TWO-PHASE FLUID MANAGEMENT FOR A RANKINE CYCLE ISOTOPE POWER SYSTEM **c34**
Timothy Bland, George Sorensen, and Kenneth Clodfelter *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 209-214 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The issue of two phase fluid management is addressed for Rankine cycle power systems operating in the zero gravity environment of space. Approaches are discussed to managing two phase flow in both the vaporizing and condensing portions of the Rankine cycle systems. A simplified Rankine cycle system block diagram is shown. Two areas where two phase flow can exist are in the vaporizer and condenser sections. Several viable approaches of managing two phase flow in a zero gravity environment exist and are presented. Author

N88-24304# Argonne National Lab., Ill. Applied Physics Div.
INTERACTION OF THE CONTROL SYSTEM WITH CORE NUCLEAR DESIGN FOR FAST SPECTRUM SPACE POWER REACTORS

R. M. Lell and N. A. Hanan *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 215-218 (For primary document see N88-24254 17-73)
(Contract W-31-109-eng-38)
Avail: NTIS HC A22/MF A01

The reactor control system and operating strategy are essential factors in assessing reactor reliability and safety. The control system and its mode of operation also exert major influences on mechanical design of core components and all aspects of nuclear design. This is especially true of reactors for space power applications because of the imposed requirements regarding compactness, minimum mass, and long term operational reliability without external intervention or maintenance. Generic features of the interaction between nuclear design and reactor control system design for fast spectrum space power reactors are outlined. Several basic control concepts were analyzed. These included ex-core control drums, in-core control rods, burnable poisons, dispersed poisons in the core, and movable fuel segments or regions. Cross sections for calculations were generated with MC sup 2 -2, and neutronics calculations were performed with the VIM Monte Carlo code, ONEDANT, and DIF3D. Author

N88-24305# Massachusetts Inst. of Tech., Cambridge.
APPLICATION OF THE REACTIVITY CONSTRAINT APPROACH TO THE TRANSIENT CONTROL OF SPACECRAFT REACTORS
John A. Bernard, Kwan S. Kwok, David D. Lanning, Allan F. Henry, and John E. Meyer *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 219-224 Sponsored in part by Draper (Charles Stark) Lab., Cambridge, Mass. (For primary document see N88-24254 17-73)
(Grant NSF CPE-83-17878)
Avail: NTIS HC A22/MF A01

The Reactivity Constraint Approach is a method used in automatic reactor control to permit power to be raised or lowered in a safe and efficient manner. Following extensive testing, this control methodology was licensed by the U.S. NRC for general use on the 5 MWt MIT Res. Reactor (MITR). The theory underlying the reactivity constraint approach is reviewed with emphasis on a supervisory technique that prevents challenges to a reactor's safety system. The development is described of a specific control law that is both compatible with the supervisory controller and suitable for operation of a high performance spacecraft. Results are presented from on-line reactor experiments and computer simulations. Author

N88-24306*# General Electric Co., Sunnyvale, Calif. Nuclear Systems Technology Operation.
REACTOR INSTRUMENTATION AND CONTROL DESIGN AND PERFORMANCE SIMULATION FOR SP-100
R. A. Meyer, A. D. Alley, F. J. Halfen, and G. V. Brynsvold *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 225-227 Sponsored in part by DOE, Washington, D.C. and DOD, Washington, D.C. (For primary document see N88-24254 17-73)
(Contract JPL-956473)
Avail: NTIS HC A22/MF A01 CSCL 18I

The SP-100 flight system will be launched with all primary and secondary lithium in the solid state. Once in orbit, the reactor will be brought critical and maintained at a low power level while the lithium is thawed out. Once the system is thawed out, the reactor power will be controlled to provide the energy source required by the power conversion system to meet the payload electrical power requirements. The Reactor Instrumentation and Control subsystem which includes the reactor control drives, instrumentation and the digital controller provides for the control of the nuclear subsystem to perform these operating maneuvers as well as providing for automatic shutdown and restart under certain off-normal conditions. The design and performance of this system are described. Author

N88-24307# Los Alamos National Lab., N. Mex. Nuclear Power Studies.
AN ADAPTIVE LOAD-FOLLOWING CONTROL SYSTEM FOR A SPACE NUCLEAR POWER SYSTEM
John D. Metzger and Mohamed S. El-Genk (New Mexico Univ., Albuquerque.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 229-232 Sponsored in part by DOE, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

An adaptive load-following control system is proposed for a space nuclear power system. The conceptual design of the SP-100 space nuclear power system proposes operating the nuclear reactor at a base thermal power and accommodating changes in the electrical power demand with a shunt regulator. It is necessary to increase the reactor thermal power if the payload electrical demand exceeds the peak system electrical output for the associated reactor power. When it is necessary to change the nuclear reactor power to meet a change in the power demand, the power ascension or descension must be accomplished in a predetermined manner to avoid thermal stresses in the system and to achieve the desired reactor period. The load-following control system described has the ability to adapt to changes in the system and to changes in the satellite environment. The application is proposed of the model reference adaptive control (MRAC). The adaptive control system has the ability to control the dynamic response of nonlinear systems. Three basic subsets of adaptive control are: (1) gain scheduling, (2) self-tuning regulators, and (3) model reference adaptive control. Author

N88-24308# Sandia National Labs., Albuquerque, N. Mex.
THE EFFECT OF ELEVATED TEMPERATURE ON IRRADIATED MOS DEVICES c33
D. M. Fleetwood and P. V. Dressendorfer *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 233-236 (For primary document see N88-24254 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A22/MF A01

Providing instrumentation and control for space based nuclear power systems requires advanced VLSI microelectronic devices. It was commonly thought that operation of devices at very high temperatures, or exposure of devices to high temperatures, would mitigate the total dose radiation induced degradation of the devices somewhat because of the annealing effects. A study is reported of the effects of very high temperature annealing on the properties of irradiated MOS transistors. The response is examined of MOS devices to room temperature irradiation, followed by extended annealing at elevated temperatures (up to 250 C). From these data it is concluded that exposure to temperatures above about 175 C does improve the response of the devices employed, but at lower temperatures the device response can depend on the detailed radiation and temperature history of the device. These results may be important to determining the optimum ambient temperature at which the devices are maintained, and should provide guidelines for choosing appropriate parts for use in space based power systems. Author

N88-24309# Sandia National Labs., Albuquerque, N. Mex.
THE RESPONSE OF A POWER MOSFET (N-CHANNEL) AND A DIELECTRIC ISOLATED OPERATIONAL AMPLIFIER TO THE COMBINED ENVIRONMENTAL EFFECTS OF HIGH TEMPERATURE AND TOTAL DOSE GAMMA RADIATION c33
W. T. Wheelis and S. M. Luker *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 237-240 (For primary document see N88-24254 17-73)
(Contract DE-AC04-75DP-00789)
Avail: NTIS HC A22/MF A01

The purpose of the series of tests described was to determine how commercially available electronic components would respond in the combined temperature/radiation environments they might see on a space nuclear powered platform. The electrical

components tested were those that reasonably could be expected to be used for instrumentation and control circuits for a space nuclear power plant. In addition, the tests were designed to determine the design margins for the devices. Another purpose of the test program was to identify the failure mechanisms for the electronic components and to make this information available to component designers. A brief description of each test and the rationale for the approach used is given. Author

N88-24310# GA Technologies, Inc., San Diego, Calif.
A REVIEW OF THERMIONIC POWER CONVERSION SYSTEMS FOR SDI APPLICATIONS **c44**
Richard C. Dahlberg, Fred Huffman, and Richard Brehm (Rasor Associates, Inc., Sunnyvale, Calif.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 241-244 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Thermionic power systems are currently under development for meeting space power requirements over the entire energy range: STAR-C, from 1 to 50 kWe; STAR-M, from 50 kW to 10 MWe; THOR, Multimegawatt burst power. STAR-M with energy storage can also provide multimegawatts of burst power. A thermionic technology program is providing a generic data base for all applications. The STAR-C is a completely static system, with heat generation occurring in a uranium-graphite core and thermionic power conversion occurring at the core reflector interface. The STAR-M thermionic power conversion occurs in-core in small flashlight battery sized thermionic cells, each producing 150 to 200 W. THOR (Thermionic Opening Reactor) is based on the use of many small thermionic energy converter modules each with its own nuclear fuel and LiH heat sink. Author

N88-24311# Rasor Associates, Inc., Sunnyvale, Calif.
ADVANCED THERMIONIC CONVERTER TECHNOLOGY FOR INDUCTIVE OUTPUT COUPLING
N. S. Rasor, J. B. McVey, J.-L. Desplat, and T. P. Sahines *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 245-248 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

A second generation in-core thermionic reactor concept has been described in which advanced mode thermionic converters are integrated into a reactor core and their output inductively coupled to an external high voltage electromagnetic circuit. The core of TRICE (Thermionic Reactor with Inductive Coupled Elements), consists of liquid metal cooled collector tubes into which simple fueled tubular emitter elements are inserted. The low voltage output power from the emitters is coupled by a single turn emitter support to an electromagnetic circuit which delivers high voltage output power to a multiturn secondary winding outside the reactor core. The feasibility of the TRICE concept depends crucially on the reduction to practice and efficient combination of previously defined basic processes, and their innovative integration into a superior thermionic reactor core structure. The advanced thermionic energy conversion and inductive output coupling aspects and their present status are summarized. Author

N88-24312# Oak Ridge National Lab., Tenn.
ASSESSMENT OF ENERGY STORAGE CONCEPTS FOR USE IN SPRINT POWER **c44**
M. Olszewski and D. G. Morris *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 249-252 (For primary document see N88-24254 17-73)
(Contracts MIPR-FY-1455-85-N0617; MIPR-FR-1455-85-N0632; MIPR-FY-1455-86-N0615)
Avail: NTIS HC A22/MF A01

Estimated sprint power levels required for space defense weapon systems are very high, with projections in the multimegawatt power range. However, these high power levels are required in a pulsed (sprint) mode where the power demand is at the high levels for short time periods. Energy can be stored in thermal storage media at the heat source and/or sink. For storage at the source, the primary power source is used to charge or heat up the thermal store. Results show that regenerable electrical storage system value is greatest for pulse durations of 500 s or less but that mass savings are still realized for generation times one and a half time as long. Flywheel energy storage shows the most benefit among near term technologies. Thus, incorporating a near term flywheel in the power supply decreases nuclear Rankine cycle system mass by 16 percent for a generation time of 500 s. Similar findings resulted from using thermal storage in the heat rejection system; namely, mass reductions of the order of 30 percent. Advances in storage component performance will result in increased value of storage to the overall power system. Author

N88-24313# Argonne National Lab., Ill.
MONOLITHIC FUEL CELL BASED POWER SOURCE FOR SPRINT POWER GENERATION **c44**
D. C. Fee, D. E. Busch, D. W. Dees, J. Dusek, T. E. Easler, W. A. Ellingson, B. K. Flandermeyer, R. J. Fousek, J. J. Heiberger, and S. Majumdar et al. *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 253-255 (For primary document see N88-24254 17-73)
(Contract W-31-109-eng-38)
Avail: NTIS HC A22/MF A01

A unique fuel cell (monolith) coupled with a low power nuclear reactor presents an attractive approach for SDI burst power requirements. The high power, long duration bursts, appear achievable within a single shuttle launch limitation with appropriate development of the concept. The feasibility of the monolithic fuel cell concept has been demonstrated. Small arrays (stacks) of the monolithic design have been operated for hundreds of hours. The challenge is to improve the fabrication technology so that larger array of the monolithic design can be operated. Author

N88-24314# Boeing Aerospace Co., Seattle, Wash. Electrical Power Systems Technology.
POWER SOURCE SELECTION FOR NEUTRAL PARTICLE BEAM SYSTEMS **c33**
Sidney W. Silverman, John W. H. Chi, and Gregory Hill (Westinghouse Electric Corp., Baltimore, Md.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 257-260 (For primary document see N88-24254 17-73)
(Contract DASG60-85-C-0076)
Avail: NTIS HC A22/MF A01

Space based neutral particle beams (NPB) are being considered for use as an SDI weapon as well as a mid-course discriminator. These systems require a radio frequency (RF) power source. Five types of amplifiers were considered for the RF power source: the klystron, the klystrode, the tetrode, the cross field amplifier, and the solid state amplifier. A number of different types of power source systems (nuclear and non-nuclear) were considered for integration with these amplifiers. The most attractive amplifier power system concepts were identified through comparative evaluations that took into account the total masses of integrated amplifier power source systems as well as a number of other factors that consisted of development cost, technology risk, vulnerability, survivability, reliability, and impacts on spacecraft stabilization. These concepts are described and conclusions drawn. Author

N88-24315*# General Electric Co., Philadelphia, Pa. Space Systems Div.
RADIATION HARDENING DESIGN OF NUCLEAR POWERED SPACECRAFT **c18**
R. E. Schmidt *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 261-262 (For primary document see N88-24254 17-73)
(Contracts JPL-956473; DE-AC03-86SF-16006)
Avail: NTIS HC A22/MF A01 CSCL 18K

The design and operation of space systems utilizing nuclear fueled power systems must consider the radiation environment

from the earliest stages of their design. A range of nuclear systems are being considered for present and future satellite systems capable of supplying tens of kilowatts to multimegawatt and generating a corresponding range of radiation environments. The effects of these radiations on electronics and materials can be minimized by implementing early design considerations which maximize the design efficiency and minimize the impact on system mass. Space systems design considerations for the radiation environment must include all sources in addition to the self induced gamma ray and neutron radiation. These include the orbital dependent environment from the high energy electron and protons encountered in natural space. The system trades which the designer must consider in the development of space platforms which utilize nuclear reactor power supplies are discussed.
Author

N88-24316*# Hampden-Sydney Coll., Va. Dept. of Physics.
NEUTRON RADIATION TOLERANCE OF Au-ACTIVATED SILICON **c76**
W. T. Joyner *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 263-264 (For primary document see N88-24254 17-73)
(Grant NAG3-605)
Avail: NTIS HC A22/MF A01 CSCL 20L

Double injection devices prepared by the introduction of deep traps, using the Au activation method have been found to tolerate gamma irradiation into the Gigarad (Si) region without significant degradation of operating characteristics. Silicon double injection devices, using deep levels created by Au diffusion, can tolerate fast neutron irradiation up to 10 to the 15th n/sq cm. Significant parameter degradation occurs at 10 to the 16th n/sq cm. However, since the actual doping of the basic material begins to change as a result of the transmutation of silicon into phosphorus for neutron fluences greater than 10 to the 17th/sq cm, the radiation tolerance of these devices is approaching the limit possible for any device based on initially doped silicon.
Author

N88-24317# Missouri Univ., Columbia. Research Reactor.
DEFECTS IN CUBIC SILICON CARBIDE ON SILICON **c76**
V. Nagesh, J. W. Farmer, R. F. Davis, and H. S. Kong (North Carolina State Univ., Raleigh.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 265-268 (For primary document see N88-24254 17-73)
(Grant NSF DMR-85-04719)
Avail: NTIS HC A22/MF A01

Recent developments making possible the growth of good quality single crystal cubic SiC epitaxial layers on Si substrate have sparked a renewed interest in this material. As grown beta-SiC on Si is characterized using photoluminescence and Deep Level Transient Spectroscopy (DLTS). DLTS results on neutron irradiated materials are reported. Photoluminescence results on thin epitaxial layers indicate a deep level that is probably due to strain. DLTS results on thin epitaxial layers also reveal a deep level in as grown material. This DLTS level may be associated with the SiC-Si interface. Taken in isolation, the DLTS results on neutron irradiated SiC indicate that this material is very resistant to damage by neutrons. However, the present DLTS experiments have sampled only the upper third of the band gap. Capacitance voltage measurements indicate that there may be a relatively large number of defects produced in the bottom two-thirds of the band gap.
Author

N88-24318# General Electric Co., Philadelphia, Pa.
ANALYSIS OF THERMAL AND RADIATION EFFECTS IN MATERIALS USING THE GEMAT PROCESS **c27**
C. P. Dulka, H. Aswathanarayana, and J. F. Scamman *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 269-274 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Organic (nonmetallic) materials are used in various applications in a nuclear power generating system as in seals, insulation, and terminal boards. These materials are susceptible to their thermal and nuclear environment and as such require an evaluation of those effects to determine operability. The GEMAT (General Electric Materials Analysis Technique) process provides a fast, cost effective means of assessing the degrading influences of temperature and radiation on materials. It addresses the specific application of the material. The GEMAT results for buna-N and silicone seals and a Rexolite insulator are reviewed. The GEMAT Process utilizes Thermogravimetric Analysis (TGA) which is a rapid thermoanalytical technique that follows the weight changes of a material as a function of temperature and time. From the TGA decomposition curves, the material's activation energy, heat resistance, radiation threshold, dose-rate effects, and estimated service life can be determined.
Author

N88-24319# Missouri Univ., Columbia. Dept. of Physics and Astronomy.
POINT DEFECTS IN IRRADIATED SILICATES **c76**
V. Priest, D. L. Cowan, F. K. Ross, and D. G. Reichel *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 275-278 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The main stumbling block in understanding radiation induced defects on an atomic level lies in the structure of amorphous SiO2, a continuous random network of linked SiO4 tetrahedra. Because of this randomness, a great deal of the power of electron spin resonance (ESR) and optics for analyzing defect structures is lost. One promising approach for recovering the lost orientation information is to examine the damage centers formed in silicate crystals. Alpha quartz studies have played an important role in unraveling the defect structure of glasses. Results are presented on radiation damage in one silicate, Al2F2SiO2 (Topaz). ESR and optical measurements were used to identify two radiation induced defects in this crystal. Both are associated with the SiO4 structural unit. The first defect has a well established counterpart in radiation damaged bulk glass. It is argued that the second defect is also likely to be an important damage center/trap in irradiated alpha-SiO2, and more specifically that it is responsible for the 2eV optical absorption band observed in irradiated and drawn glass fibers.
Author

N88-24320# New Mexico Univ., Albuquerque. Inst. for Space Nuclear Power Studies.
SPACE NUCLEAR REACTOR SHIELDING OPTIMIZATION STUDIES
Richard D. Jimenez and Mohamed S. El-Genk *In its* Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 279-284 Prepared in cooperation with Aerospace Corp., Albuquerque, N. Mex. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The Institute for Space Nuclear Reactor Studies is investigating optimal techniques for shielding spacecraft (payload) electronics from the combined radiation effects of the SP-100 system nuclear reactor core and the natural space environment. The academic challenge of this research includes the investigation of the combined influences of radiation from the space environment and the radiations from the reactor power source. The technical application includes a series of shielding mass penalty tradeoffs for the SP-100 Program concept between the reactor core shield and the additional shielding of the spacecraft enclosure. These mass penalty tradeoffs are being conducted for several space flight orbits of future interest to the space military and civilian communities. It was shown that several potential mission orbits may pose environmental radiation dosages which are more severe than the SP-100 specification of core escape neutron and gamma ray particle fluences incident on the spacecraft.
Author

N88-24321# General Electric Co., Philadelphia, Pa. Space Systems Div.
TURBOMACHINERY IN SPACE **c37**
T. S. Chan, W. S. Chiu, R. E. Troeger, and M. Shah *In* New

Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 285-288 (For primary document see N88-24254 17-73)
(Contract F33615-85-C-2544)
Avail: NTIS HC A22/MF A01

The need to supply high levels of electrical power in the multimegawatt (MMW) range for short durations, such as the Strategic Defense Initiative (SDI) missions, is anticipated in future space applications. A potential power subsystem candidate based upon near-term technology is the turbogenerator consisting of a power turbine driving a generator or alternator. Numerous studies have shown that turbogenerators using either nuclear or chemical heat source can provide the burst MMW power at lowest system mass. However, no full consideration has yet been given to other essential issues associated with operating the power subsystem, such as dynamic interactions with the spacecraft, thermal management, fuel storage and control, and effluent management. The status of a 3 year study to assess the feasibility of turbomachinery for space application is presented. The hardware studied includes: the turbine and its components; the electrical generator and power conditioning elements; and the space platform design. The effects, interactions, and performance of all subsystems are analyzed. Author

N88-24322# Oak Ridge National Lab., Tenn.
AN EXPERIMENT TO INVESTIGATE RANKINE CYCLE TWO-PHASE MICROGRAVITY ISSUES **c29**
G. L. Yoder and E. D. Brewer *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 289-292 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The Rankine cycle is an attractive power conversion option for space application as it provides a high power output per unit mass or volume. The boiler portion of the cycle is required to provide nearly all vapor to the turbine either directly or through a liquid/vapor separation system. The two phase mixture which leaves the turbine is recondensed to 100 percent liquid in the radiator and a feed pump returns the condensed liquid to the boiler inlet. An experiment is described which is being developed to investigate two phase flow issues critical to microgravity operation of the Rankine cycle. Author

N88-24323# Pacific Northwest Labs., Richland, Wash.
DESIGN OF A HIGH-POWER-DENSITY LJUNGSTROEM TURBINE USING POTASSIUM AS A WORKING FLUID **c37**
Edmund P. Coomes, Ryan E. Dodge, D. G. Wilson, and S. J. McCabe (Massachusetts Inst. of Tech., Cambridge.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 293-298 (For primary document see N88-24254 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A22/MF A01

An advanced multimegawatt space power system employing a liquid metal Rankine power cycle can meet the needs of future space programs, especially if a high power density turbine is used. The Ljungstroem turbine is an ideal turbine for use in space because it provides a compact, high power density turbine with balanced rotational inertia and it is tolerant of moisture in the working fluid. A preliminary design study indicates that high power Ljungstroem turbines, using potassium as a working fluid, are feasible, and that Ljungstroem turbines of 200 MW and greater could easily fit into the cargo bay of the space shuttle. The Ljungstroem turbine is described and its advantages and disadvantages are given. The turbine design is also given along with the results of testing. Author

N88-24324*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AMTEC ELECTRODE DEVELOPMENT **c44**
C. P. Bankston, R. M. Williams, B. J. Nakamura, B. L. Wheeler, M. E. Loveland, and T. Cole *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 299-301 Sponsored by NASA, Washington, D.C. and Space Defense Initiative Organization, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 18K

The Alkali Metal Thermoelectric Converter (AMTEC) is a direct energy conversion device, utilizing a high sodium vapor pressure or activity ratio across a beta-alumina solid electrolyte. Progress is reported on a long life, high power, porous electrode. Two electrode compositions were identified which have the potential for long life operation at power densities above 0.5 W/sq cm. Longer lifetime testing is being initiated. Successful optimization and demonstration of very long lifetimes for these electrodes will be a major step toward establishing the feasibility of AMTEC space power systems. Author

N88-24325# Ford Motor Co., Dearborn, Mich.
SODIUM HEAT ENGINE/AMTEC SYSTEM EXPERIMENTS **c44**
T. K. Hunt, J. V. Lasecki, R. F. Novak, J. R. McBride, and J. T. Brockway *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 305-307 (For primary document see N88-24254 17-73)
(Contract DE-AC02-83CE-40651)
Avail: NTIS HC A22/MF A01

The Sodium Heat Engine (SHE) or Alkali Metal Thermoelectric Converter (AMTEC) is a high efficiency device for the direct conversion of heat to electricity. The SHE system operates as a thermally regenerative concentration cell using sodium as the working fluid. Its operation relies on the high sodium ion conductivity and low electronic conductivity of sodium beta-alumina solid electrolyte. The SHE/AMTEC is a static system employing no moving parts, uses sodium as the single working fluid, and offers the prospect of excellent reliability. The major operating features of the SHE/AMTEC system have been tested in lab studies of systems at power levels up to 100 W. Goals of the present program include the design, construction and testing of systems at power levels up to the 1 kW level. While these and all previously tested SHE systems have been designed for terrestrial applications, several concepts to be considered in the design of kW level devices should yield information useful for the development of systems for space power applications. Author

N88-24326# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
DEVELOPMENT OF RELIABLE FUEL PINS FOR SPACE REACTOR APPLICATIONS
A. Boltax, B. E. Sundquist, and A. Biancheria *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 309-312 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Uranium nitride and oxide fuel pins with refractory alloy cladding are being developed for use in lithium cooled compact space nuclear reactors. Operational requirements include steady state operation for 7 to 10 years and operation at various power levels. One of the critical problems that must be solved to achieve the program goals involves the fuel dimensional stability (fuel fragmentation, swelling and vaporization). The benefits obtained by using refractory metal felt between fuel and cladding to enhance dimensional stability are described. It is expected to reduce the general level of cladding mechanical strain as well as local cladding strain effects due to misalignment of pellet fragments and pellet end effects (bambooing). The reduction of general and local cladding strain is expected to lead to improved mechanical reliability of refractory metal clad fuel pins. Author

N88-24327# New Mexico Univ., Albuquerque. Inst. for Space Nuclear Power Studies.
URANIUM NITRIDE FUEL SWELLING AND THERMAL CONDUCTIVITY CORRELATIONS
Mohamed S. El-Genk, Steven B. Ross, and R. Bruce Matthews (Los Alamos National Lab., N. Mex.) *In its* Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987

p 313-317 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The results of ongoing research is presented from the investigation of the swelling behavior of UN (uranium nitride) fuel. The primary objectives of this research are: (1) to review and analyze the uranium nitride fuel swelling and thermal conductivity data, (2) to develop a UN thermal conductivity correlation for the temperature range of interest to the SP-100 system design, and (3) to develop a general fuel swelling correlation for UN fuel with Nb-1 percent Zr to Nb-1 percent Zr-0.1 percent cladding material. A major uncertainty in correlating fuel performance data is the actual fuel operating temperature. By recalculating the fuel temperature using the same approach for all irradiation tests, a more realistic correlation can be developed. Author

N88-24328# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
A REVIEW OF DIFFUSION BARRIER TECHNOLOGY FOR APPLICATION IN SP-100 FUEL PINS
M. A. Schmidt and M. J. Kanis *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 319-322 (For primary document see N88-24254 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A22/MF A01

The SP-100 reactor is compact, lithium cooled, and designed to operate in a space environment. The fuel element uses sintered uranium nitride pellets contained in a Nb alloy cladding. A diffusion barrier compatible with both the fuel and cladding and that physically separates the two is necessary to prevent chemical reactions between them. Various methods of fabricating effective diffusion barriers were investigated by NASA and NASA contractors. Fabrication methods investigated to produce tungsten diffusion barriers for two reactor concepts are listed and results are given. Author

N88-24329# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
CERMET FUEL THERMAL CONDUCTIVITY
J. M. Alvis, J. K. Thomas, and K. L. Peddicord *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 323-326 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Cermet fuels have been identified as a candidate fuel for multimegawatt reactor designs which require rapid power changes, based on their potential for high thermal conductivity and good thermal shock resistance. Cermet fuels consist of ceramic fuel particles dispersed with a metal matrix. The conductivity of the cermet depends on the size, shape and orientation of the fuel particles, as well as the relative amounts of fuel and matrix material. This study investigates analytical methods of predicting the thermal conductivity of cermets, compare these methods with available experimental results and develop a computer code to model the thermal conductivity. Author

N88-24330*# Wisconsin Univ., Madison. Fusion Technology Inst.
HELIUM-3 FUSION FUEL RESOURCES FOR SPACE POWER
L. J. Wittenberg, J. F. Santarius, and G. L. Kulcinski *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 327-330 Sponsored by NASA, Washington, D.C., Wisconsin Electric Utility Research Foundation and the Grainger Foundation (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 18K

The need to develop fusion power for multimegawatt extraterrestrial space station and for large, deep-space propulsion systems is recognized. This need is based upon the fact that fission nuclear fuels release nearly 1000000 times more energy than chemical fuels while fusion fuels release approx. 3 times as much energy as fission fuels on a mass basis. Additionally, fusion fuels utilizing the easily fusible hydrogen and helium isotopes are 10 to the 10th times more numerically abundant in the solar system than the fission fuel, U-235. Consequently, fusion fuel resources and conceptual design studies of fusion power plants must be developed for potential application as e::traterrestrial power sources. The abundant resource of lunar He-3 makes it imperative to consider this fusion fuel for space power applications. Such use may include, Earth orbiting power stations, lunar and Martian base camp power stations, and perhaps propulsion systems for distant planetary missions. Author

N88-24331# Science Applications International Corp., Albuquerque, N. Mex.
THERMAL MANAGEMENT FOR MULTI-MODAL NUCLEAR POWER PLANTS
David Buden and James Mims *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 331-334 (For primary document see N88-24254 17-73)
(Contract DE-AC03-85SF-15928)
Avail: NTIS HC A22/MF A01

Refractory metals are the lightest weight material, with molybdenum alloys favored, and liquid metals the preferred working fluid, with lithium favored. Detailed assessment of vapor heat storage in comparison to radiator devices reveals that, for the energy levels of interest, heat rejection is always lighter than vapor heat storage because it allows modularization of radiator elements into small sections and takes advantage of very thin structural membranes. Extensions of the heat rejection concepts result in significantly improved heat rejection systems in comparison with more conventional approaches. The heat rejection radiator concept for pulse power can be reduced by a factor of 5 or more from extensions of conventional radiator designs. Author

N88-24332# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
A THERMAL EQUILIBRIUM MODEL FOR MULTI-MEGAWATT SPACE PLATFORMS c18
Mark David DeHart *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 335-338 Sponsored by DOE, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Due to the current research under the SDI and the SP-100 Project, much work is being done to determine the optimum design for a space based nuclear powered platform. The problem of thermal equilibrium temperature distributions which would be experienced on a multimegawatt platform using a nuclear reactor driven thermodynamic cycle for production of several megawatts of electrical power over extended periods of time, the temperatures to which electronics packages on the platform would be subjected, and what measures needed to ensure that such electronics could survive is addressed. Anticipated electronics used on such a platform may be able to withstand steady state temperatures of up to 600 K, while current high temperature electronics are limited to 475 K. Therefore, an effort is made to determine the conditions and requirements to be imposed on a platform that would result in temperatures at critical locations between 475 and 600 K. A numerical model was developed to estimate outer surface temperatures and radioisotopes based on radiation heat transfer. In this model, the effects of space, Earth, and Sun are represented by an averaged sink temperature of 250 K. Author

N88-24333# Los Alamos National Lab., N. Mex.
A REVIEW OF IMPACT DESIGN CRITERIA FOR SPACE POWER HEAT REJECTION SYSTEMS c18
Lynn B. Lundberg *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 339-342 Sponsored by DOE, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The presence of both natural and man-caused small, solid particles in space that move at velocities of the order of tens of k/s represents a real threat to the survivability of large area heat

rejection components that will be required for space nuclear power systems. Protection of surfaces expected to survive long periods in space from impact damage by this natural threat is a dominant aspect of space power hear rejection system design. Guidelines have been developed for the meteoroid impact protection of spacecraft from space debris threats (Swift, 1982), while guidelines for the development of survivable heat rejection systems in space have been only partly developed. The space environmental criteria used to develop a design is outlined and discussed and the design criteria for several generic space power heat rejection systems is reviewed. Author

N88-24334# Toledo Univ., Ohio. Dept. of Mechanical Engineering.
TRANSIENT ANALYSIS OF LI AND LIH THERMAL STORAGE SPHERES **c44**
Douglas L. R. Oliver *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 343-346 (For primary document see N88-24254 17-73)
(Contract F49620-85-C-0013)
Avail: NTIS HC A22/MF A01

Thermal storage devices are of interest in space based thermal systems to act as a heat sink for rapid pulses of waste energy. For space based systems it is desirable that the thermal storage device have a high thermal capacity. Two materials with high thermal capacities between the range of 300 and 1200 K are lithium and lithium hydride. To contain these materials an outer shell of some metallic or ceramic material is envisioned. It is assumed that liquid Li or LiH will wet the wall of the containment shell. And as the Li or LiH solidifies, a void is expected to form in the center of the sphere. Several technical problems associated with such thermal storage spheres are present. Transient heat transfer to the spheres is addressed as one of these problems. Author

N88-24335# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF SWIRL FLOW PHASE SEPARATORS FOR MICROGRAVITY APPLICATIONS **c29**
Vladimir Valentekovich, Daniel J. Pafford, and Vijay K. Dhir *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 347-350 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

A method of separating a mixture of vapor and liquid has been proposed for use in microgravity environments. The method consists of using centripetal acceleration introduced by swirling flow within a circular cylinder to force the denser phase radially outward thereby forcing the less dense phase radially inward to form a gaseous core. An optimum separator design and predictable operation requires a detailed theoretical analysis of such a device as well as experimental verification. The separation of a mixture of gas and liquid as might be obtained in the vapor generating or condensing stage of a Rankine power cycle is investigated. Such a separation technique might also be necessary to separate any entrained droplets in the gas flow or entrained gas in the liquid film of the liquid droplet heat exchanger concept of Bruckner and Shariatmadar. Also considered is the inlet gas to liquid volume ratios that are much larger than those studied by Kearsey and Hibbert. Author

N88-24336# Avco-Everett Research Lab., Mass. Military Power Programs.
NUCLEAR REACTOR MAGNETOHYDRODYNAMIC POWER GENERATOR FOR DIRECTED ENERGY WEAPONS **c75**
Daniel W. Swallom *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 351-354 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The SDI electrical power requirements for directed energy weapons (DEW) may range from tens of megawatts to over hundreds of megawatts. For this application, where the power requirement is continuous for a period to time ranging from tens to hundreds or thousands of seconds, nuclear magnetohydrodynamic (MHD) power generation provides an attractive method for producing the required power levels. The MHD power system offers the advantages of simplicity of operation because of no moving or rotational parts; no upper limit on gas inlet temperature, which is a restriction in the case of rotating machinery; an upper limit on current output, which prevents the output current from exceeding twice the nominal current; and favorable scaling to larger size systems. Author

N88-24337# California State Univ., Long Beach. Innovative Nuclear Space Power Inst.
FUNDAMENTAL ANALYSIS OF SPACE NUCLEAR-MHD GENERATOR FOR GIGAWATT-LEVEL POWER **c75**
Julius Goodman, Isaac Maya, and J. Richard Williams *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 355-359 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

SDI applications are likely to require SPRINT power sources with GWe-level potential at power densities of 1 kWe/kg. This goal for closed cycle systems can potentially be achieved with a combination of a nuclear gas core reactor and an MHD generator. The nuclear gas core reactor can deliver high volumetric density energy production and the MHD generator can provide high volumetric density energy conversion. A preliminary fundamental feasibility analysis of space nuclear MHD plants is presented. Author

N88-24338# Ben Gurion Univ. of the Negev, Beersheva (Israel). Center for MHD Studies.
LIQUID-METAL MHD POWER CONVERSION FOR SPACE ELECTRIC SYSTEMS **c75**
L. Blumenau, H. Branover, A. El-Boher, E. Spero, S. Sukoriansky, and E. Greenspan (Israel Atomic Energy Commission, Beersheba.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 361-366 Sponsored by SOLMECS Corp. and Israel Ministry of Industry and Trade (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The design environment for Space Electric Systems (SES) demands high specific power and high specific energy conversion system as well as components that are highly reliable. Liquid Metal Magnetohydrodynamic (LMMHD) technology may combine the advantages of general MHD power generation, in terms of specific power, flexibility and reliability, with the enhanced heat transfer capabilities offered by liquid metals which are already envisioned for use in space reactor electric systems. A number of synergistic configurations using liquid metals as the main reactor coolant, radiator fluid, or to provide some radiation shielding, have been conceived. This also has positive implications for burst power capability where the ability to rapidly absorb and deliver energy is a necessity and where MHD systems already show significant advantage. Being free of rotating machinery is another potential advantage as is an ability to operate at higher temperatures. A number of LMMHD Power Conversion Systems recently conceived for SES applications are described and their performance analyzed. Author

N88-24339# Institut de Mecanique de Grenoble (France).
STUDIES FOR THE DEFINITION OF A FARADAY CONVERTER FOR SPACE NUCLEAR SYSTEMS **c75**
A. Alemany, R. Laborde, Ph. Marty, J. P. Thibault, and F. Werkoff (Commissariat a l'Energie Atomique, Grenoble, France) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 367-369 Sponsored by CNRS, France and CNES, France (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

A rundown is presented of the research at Grenoble on metal-gas Faraday (or liquid metal magnetohydrodynamics) conversion. The principles of this type of conversion is reviewed. Then the results of the French research program, which is mainly concentrated on induction generators and two flow acceleration and separation processes, are presented. A preliminary estimation of the characteristics of a lithium-cesium 200 kWe Faraday converter is given. Author

N88-24340# Pacific Northwest Labs., Richland, Wash.
DESIGN OF A SUPERCONDUCTING ALTERNATOR FOR SPACE-BASED POWER GENERATION **c33**
Ryan E. Dodge, Jr., Edmund P. Coomes, and James L. Kirtley, Jr. (Massachusetts Inst. of Tech., Cambridge.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 371-376 (For primary document see N88-24254 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A22/MF A01

Superconducting alternators promise several advantages which make them an attractive choice for space power systems. They are smaller and lighter than conventional alternators. The physical property exploited by the superconducting alternator is the near zero resistivity that some materials exhibit at very low temperatures. Machine reactance is another area of consideration in the design of electric machines. The alternator designs described are based on a prototype machine (Ula, 1980), constructed at MIT. The MIT machine is designed to meet industrial requirements for faultworthiness and stability. The whole rotor is operated at deep cryogenic temperature. It uses a two element shielding and damping scheme. It employs a fiber reinforced plastic vacuum vessel which doubles as the inner support tube for the armature winding. The helical winding is also adaptable to implementation of highly effective insulating schemes. The superconducting alternator is further described and a list of results of calculations for comparison with 2 other types of systems is given. Design constraints are also listed. Author

N88-24341# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
TRANSIENT ANALYSIS OF HEAT PIPE VAPOR DYNAMICS **c34**
Daniel B. Klein and Ivan Catton *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 377-380 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

A study of the transient performance of high temperature heat pipes is presented. Focus of the analysis is on the vapor core region. Key to understanding difficulties in heat pipe startup is a knowledge of transient vapor dynamics in the core: how the vapor responds to changing evaporation and condensation rates. The possible response of the vapor to a stepped temperature in the evaporator is shown. Results of analysis allows the prediction of the velocity, pressure and temperature variations of the vapor as a function of time due to varying boundary conditions. Author

N88-24342# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
PROGRESS IN THE COMPUTER MODELING OF THE LIQUID PHASE BEHAVIOR OF A LIQUID METAL HEAT PIPE **c34**
Gregory L. Roche and Ivan Catton *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 381-384 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Of growing interest is transient heat pipe operation. This expanded interest is due to potential heat pipe applications that require reliable operation during severe transients. A space based nuclear generating station using liquid metal heat pipes (LMHPs) for core heat removal is an example of such an application. A program is underway to examine the transient operation of LMHPs. The efforts related to developing a computer model of the liquid phase behavior of a LMHP is discussed. Specifically, the fundamental issues requiring resolution in order to theoretically define transient operation is presented. The underlying fundamental heat and mass transport phenomena is investigated. Some of these phenomena, such as the liquid meniscus behavior, are qualitatively quite different from the usual assumptions that yield satisfactory steady state results. Author

N88-24343# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A COMPRESSIBLE VAPOR FLUX MODEL FOR TRANSIENT HEAT PIPE ANALYSIS **c34**
W. Jerry Bowman and James Hitchcock *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 385-388 Sponsored by AFWAL, Wright-Patterson AFB, Ohio (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Research to devise efficient methods of numerically modeling the vapor flow in a heat pipe is described. Emphasis is made to study highly compressible flow situations. Preliminary results are presented. First, the numerical methods being used to model the flow situation is reviewed. Next, the experimental apparatus used to gather data to validate the model is described. Lastly, the numerical model results is compared with experimental data. Author

N88-24344# Idaho National Engineering Lab., Idaho Falls.
ATHENA HEAT PIPE TRANSIENT MODEL **c34**
Victor H. Ransom and Hueiming Chow (Exxon Nuclear Co., Inc., Richland, Wash.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 389-392 (For primary document see N88-24254 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A22/MF A01

The ATHENA (Chow 1985) is a general purpose thermal hydraulic transient simulation code that was developed for the Magnetic Fusion Safety Project. The ATHENA two fluid model for two phase flow was modified to include the fluid physics unique to the heat pipe. This approach has resulted in a relatively sophisticated heat pipe transient model for a modest development effort. The model was used to simulate heat pipes for space power reactors, both as separate components and in integral simulation of coupled systems. The modifications that were made to the two fluid model to enable heat pipe simulation are described. Author

N88-24345# Costello (Frederick A.), Inc., Herndon, Va.
DETAILED TRANSIENT MODEL OF A LIQUID-METAL HEAT PIPE **c34**
Frederick A. Costello, Allen F. Montague, Michael A. Merrigan, and Robert Reid (Los Alamos National Lab., N. Mex.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 393-402 Previously announced as N87-10257 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

A detailed transient model of a liquid metal heat pipe was developed. The model includes start from the frozen state, with provision for free molecule flow, and proceeds through the steady state operating conditions. The KACHINA method was selected for simulating the compressible flow in the core. The SIMPLER method was selected for simulating the liquid flow in the wicks and grooves. The computational methods were demonstrated on a Compaq Deskpro II. The FORTRAN cove was converted to the IBM 3033 and Cray I. Based on the ratio of Cray to Compaq speeds, the Cray computation times was estimated to be 30 minutes per hour simulated. Author

N88-24346# Los Alamos National Lab., N. Mex.
THERMOCHEMICAL ANALYSIS OF MASS TRANSFER IN A NB-1ZR-POTASSIUM HEAT PIPE **c34**
Roy C. Feber and Michael A. Merrigan *In* New Mexico Univ.,

Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 403-406 (For primary document see N88-24254 17-73)
(Contract W-7405-eng-36)
Avail: NTIS HC A22/MF A01

A computer program was written to model the time dependent distribution of pertinent chemical species along the length of heat pipes which use alkali metals as working fluids. The heat pipe is considered to be divided into a number of zones containing a gas phase, a liquid alkali metal phase, and an assemblage of solids at equilibrium. A complex chemical equilibrium calculation is performed at each time step within each zone. The equilibrium calculation determines the identities and amounts of species in the gas phase, the liquid alkali metal phase, and any precipitating solid phases. The latter are assumed to be immoble. Following equilibrium calculations, gaseous and liquid alkali metal and chemical species dissolved in them are transferred in the direction and amount corresponding to the flow scheme and power of the heat pipe and the size of the time step. Transport of impurity elements is possible because the distribution coefficients between the liquid and gas phases are not unity and the formation of precipitation is possible. The net result is that mobile contaminant containing species tend to collect in the evaporator section of the heat pipe where they cause localized enhanced corrosion.
Author

N88-24347# North Carolina State Univ., Raleigh. Dept. of Nuclear Engineering.
TRANSIENT THERMOHYDRAULIC HEAT PIPE MODELING **c34**
Michael L. Hall and Joseph M. Doster *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 407-410 Sponsored by DOE, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Many space based reactor designs employ heat pipes as a means of conveying heat. In these designs, thermal radiation is the principle means for rejecting waste heat from the reactor system, making it desirable to operate at high temperatures. Lithium is generally the working fluid of choice as it undergoes a liquid-vapor transformation at the preferred operating temperature. The nature of remote startup, restart, and reaction to threats necessitates an accurate, detailed transient model of the heat pipe operation. A model is outlined of the vapor core region of the heat pipe which is part of a large model of the entire heat pipe thermal response. The vapor core is modeled using the area averaged Navier-Stokes equations in one dimension, which take into account the effects of mass, energy and momentum transfer. The core model is single phase (gaseous), but contains two components: lithium gas and a noncondensible vapor. The vapor core model consists of the continuity equations for the mixture and noncondensible, as well as mixture equations for internal energy and momentum. Author

N88-24348# Ebasco Services, Inc., New York.
A LIQUID METAL MHD CONCEPT FOR MULTIMEGAWATT SPACE POWER APPLICATION **c75**
J. R. Bilton, R. L. Hensler, V. A. Walker, B. L. Rushton, R. G. Ambrosek, B. G. Schnitzler, F. J. Wheeler, V. W. Storhok, J. A. Lake, and R. P. Wadkins (Idaho National Engineering Lab., Idaho Falls.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 411-414 (For primary document see N88-24254 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A22/MF A01

The need for space power at very high levels in the hundreds of megawatts range, for short period of time, coupled with the need for moderately high power levels, in the tens of megawatts for extended periods, places unique requirements on the energy system designer. The system discussed is designed to meet the requirements for burst power levels of 300 to 600 MWe and alert power of less than 50 MWe. For a space power system, high reliability and low specific weight and volume are driving requirements. Efficiency is important to the extent that it influences system weight and low efficiency places extreme requirements on the energy source. Liquid metal MHD is a passive energy conversion process and thereby minimizes the number of rotating components. A liquid metal cooled fast reactor provides the heat source for the liquid metal MHD working fluid, while retaining a relatively compact core configuration for this range of powers. The power system studied is based on a two phase flow liquid metal MHD generator with lithium as the electrodynamic fluid and helium as the thermodynamic fluid.
Author

N88-24349# Martin Marietta Energy Systems, Inc., Oak Ridge, Tenn.
NUCLEAR RANKINE/FLYWHEEL MMW SPACE POWER CONCEPT **c44**
J. P. Nichols, R. S. Holcomb, J. C. Moyers, and D. U. OKain *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 415-418 (For primary document see N88-24254 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A22/MF A01

A paper in the 1st Symposium on Space Nuclear Power Systems (Jones, 1984) proposed a megawatt power concept in which a fast reactor with boiling potassium coolant and a direct potassium Rankine power conversion cycle is coupled with a burst power system that uses modules of flywheel motor generators. The evolving technological features of the concept, the status of development of the technology, and needs for additional research and development are presented.
Author

N88-24350# Lawrence Livermore National Lab., Calif.
GAS-COOLED REACTOR POWER SYSTEMS FOR SPACE
Carl E. Walter *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 419-422 (For primary document see N88-24254 17-73)
(Contract W-7405-eng-48)
Avail: NTIS HC A22/MF A01

Large amounts of electric power are required for some of the systems envisioned in support of SDI. Since various applications are being considered, and an overall power architecture study has not been completed, the required power levels and corresponding operating times for specific systems are not known. The characteristics of six designs for power levels of 2, 10 and 20 MWe for operating time of 1 and 7 yrs are described. The operating conditions for these arbitrary designs were chosen to minimize system specific mass. Both gas and liquid cooled reactors are considered. The designs discussed draw heavily on the Pluto project experience. Gas cooled thermal reactors coupled with Brayton cycle power conversion appear to provide reasonable multimegawatt space power systems. An advanced radiation design must be developed which can meet the mass limit assumed. The inherent high temperature capability of the reactors considered removes the reactor as a limiting condition on system performance.
Author

N88-24351*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF CLOSED CYCLE MEGAWATT CLASS SPACE POWER SYSTEMS WITH NUCLEAR REACTOR HEAT SOURCES **c20**
A. J. Juhasz and B. I. Jones *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 423-426 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 21H

The analysis and integration studies of multimegawatt nuclear power conversion systems for potential SDI applications is presented. A study is summarized which considered 3 separate types of power conversion systems for steady state power generation with a duty requirement of 1 yr at full power. The systems considered are based on the following conversion cycles: direct and indirect Brayton gas turbine, direct and indirect liquid metal Rankine, and in core thermionic. A complete mass analysis was performed for each system at power levels ranging from 1 to

25 MWe for both heat pipe and liquid droplet radiator options. In the modeling of common subsystems, reactor and shield calculations were based on multiparameter correlation and an in-house analysis for the heat rejection and other subsystems.
Author

N88-24352# Sandia National Labs., Albuquerque, N. Mex.
THE EFFECT OF OPERATING TEMPERATURE ON OPEN, MULTIMEGAWATT SPACE POWER SYSTEMS
M. W. Edenburn *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 427-430 Previously announced as N87-30169 (For primary document see N88-24254 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A22/MF A01

Reactor powered and combustion powered multimegawatt, burst mode, space power systems were studied to evaluate the effect of turbine inlet temperature will have on their performance and mass. Both systems will provide power to space based antiballistic missile weapons that require hydrogen for cooling, and both use this hydrogen coolant as a working fluid or as a fuel for power generation. The quantity of hydrogen needed for weapon cooling increases as the weapon's cooling load increases and as weapon coolant outlet temperature decreases. Also, the hydrogen needed by the turbines in both power systems increases as turbine inlet temperature decreases. When weapon cooling loads are above 40 to 50 percent of weapon power and weapon coolant outlet temperature is below 300 to 400 K, the weapon needs more hydrogen than the turbine in either the reactor or combustion powered systems using turbine inlet temperatures consistent with current material technology. There is very little system mass reduction to be gained by operating a burst mode power system at a turbine inlet temperature above present material temperature limits unless the weapon's cooling load is below 40 to 50 percent or coolant outlet temperature is above 300 to 400 K. E.R.

N88-24353*# Sandia National Labs., Albuquerque, N. Mex.
COMPARISON OF OPEN AND CLOSED MULTIMEGAWATT SPACE POWER SYSTEMS
D. R. Gallup and M. W. Edenburn *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 431-434 Previously announced as N88-10579 Sponsored in part by NASA, Lewis Research Center, Cleveland, Ohio (For primary document see N88-24254 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A22/MF A01 CSCL 18I

One of the major questions that is being addressed at present by SDI Multimegawatt Space Power Project is whether or not space weapon power systems must be closed, i.e., whether effluents from the systems are tolerable. If they are not tolerable, the major penalty that must be paid to close space systems is increased mass. Open systems remove waste heat by producing effluents, e.g., hot hydrogen gas. Closed systems require radiators, thermal storage masses, effluent storage, or refrigeration to remove waste heat. The mass penalty incurred by addition of these devices is so severe that the option of closing space power systems should be avoided if at all possible. The mass penalty is even more severe if the weapon system itself must also be closed. Author

N88-24354# New Mexico Univ., Albuquerque. Inst. for Space Nuclear Power Studies.
A DYNAMIC MODEL FOR THE AFT ACCUMULATOR IN THE TE SP-100 SYSTEM
Mohamed S. El-Genk, Samantha N. Lapin, and Jong T. Seo *In its* Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 435-440 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

A dynamic model of the aft accumulator for the thermoelectric SP-100 baseline system is presented. The effects of the accumulator's various design parameters on the coolant's operating pressure is also discussed. These parameters include the initial pressure of the fill gas, P sub o; the system nominal pressure, P sub n (the coolant pressure at the reactor nominal thermal power of 2.0 MWt); and the ratio of the coil diameter-to-the mean diameter of the compression spring, d/D. Analysis shows that a gas charged spring aft accumulator provides an effective means for accommodating the thermal expansion and contraction of lithium coolant during startup and steady state operation of the system. The results also show that the reactor system can be operated above the saturation curve for lithium. Author

N88-24355*# Sandia National Labs., Albuquerque, N. Mex.
RSMASS: A SIMPLE MODEL FOR ESTIMATING REACTOR/SHIELD MASSES
Albert C. Marshall *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 441-444 Sponsored in part by NASA, Lewis Research Center, Cleveland, Ohio (For primary document see N88-24254 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A22/MF A01 CSCL 18I

A comparison was completed of the reactor/shield masses obtained from detailed calculations by the proposers of space power reactors. This comparison included a variety of liquid metal cooled, gas cooled and thermionic reactors. An initial goal for agreement between RSMASS (reactor/shield mass model) calculated masses and the masses obtained from detailed calculations was chosen to be a factor of 2. The preliminary comparison demonstrated that the reactor/shield masses estimated by RSMASS agree with the masses obtained from detailed calculations within 50 percent. It can be concluded that RSMASS can provide good estimates of reactor/shield masses for a broad variety of reactor concepts proposed for MMW space power applications. RSMASS is being used to compare the masses of various reactor types and is providing some insights into the mass advantages and disadvantages for the various concepts as a function of operating conditions and reactor or shield parameters. Some mass estimates obtained with RSMASS are presented.
Author

N88-24356*# General Electric Co., Sunnyvale, Calif. Nuclear Systems Technology Operation.
SP-100 CONTROL SYSTEM MODELING
R. A. Meyer, F. J. Halfen, and A. D. Alley *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 445-448 Sponsored by part by DOE, Washington, D.C. and DOD, Washington, D.C. (For primary document see N88-24254 17-73)
(Contract JPL-956473)
Avail: NTIS HC A22/MF A01 CSCL 18I

SP-100 Control Systems modeling was done using a thermal hydraulic transient analysis model called ARIES-S. The ARIES-S Computer Simulation provides a basis for design, integration and analysis of the reactor including the control and protection systems. It is a modular digital computer simulation written in FORTRAN that operates interactively in real time on a VAX minicomputer.
Author

N88-24357# Idaho National Engineering Lab., Idaho Falls.
ATHENA SIMULATION OF THE 300 kW SP-100
Paul A. Roth *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 449-452 (For primary document see N88-24254 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A22/MF A01

The Advanced Thermal Hydraulic Energy Network Analyzer (ATHENA) code is capable of simulating the thermal hydraulic behavior of a wide variety of thermal hydraulic systems which may be found in space reactors, advanced fission reactors, fusion reactors, and other new techniques. The code uses a two fluid hydrodynamic model that allows unequal phasic velocities and temperatures within a control volume. The capability of the ATHENA computer code to simulate the transient response of a space reactor to a bomb blast was demonstrated. The bomb-produced effects on the system were approximated and the system response was followed. The ATHENA code proved to be a useful tool in

studying transient heat pipe behavior in a zero gravity environment. Even though the transient had a major impact on the system it did not appear to cause any conditions which the SP-100 would not be able to withstand. Author

N88-24358# New Mexico Univ., Albuquerque. Inst. for Space Nuclear Power Studies.
PARAMETRIC ANALYSES OF THE TE SP-100 SYSTEM PERFORMANCE
Mohamed S. El-Genk and Jong T. Seo *In its* Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 453-458 (For primary document see N88-24254 17-73)
(Contract F129601-74-C-0080)
Avail: NTIS HC A22/MF A01

It was shown that utilizing high temperature cladding material significantly increases the net electric power output of the thermoelectric SP-100 system without increasing the size and mass of the nuclear reactor. It was also shown that replacing the Nb-1 percent Zr cladding material with PWC-11 or Mo-14 percent Re increased the system's maximum electric power from about 122 to 163 and 209 kWe, respectively. Author

N88-24359# Florida Inst. of Tech., Melbourne. Space Technology Programs.
A PROPOSED NATIONAL POLICY CONCERNING THE REENTRY OF SPACE REACTORS
Joseph Angelo, Jr. and David Buden (Science Applications International Corp., Albuquerque, N. Mex.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 459-462 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Current U.S. policy on use of space reactors is to operate the reactors in orbits that have enough duration to allow for radiological decay to safe biological levels before reentry into the Earth's biosphere or to provide a booster system to raise reactors that operate in lower orbits to the higher orbits after end of life. A policy is proposed which would avoid any reentry of space reactors into the biosphere once operated in space. This policy change is possible because of the evolving space station infrastructure. This requires planning both on the part of the nuclear power plant and the space station infrastructure designers. Once the elements of the policy are implemented, a broader range of applications can open up, since the concerns of operating in low Earth orbit will be significantly lessened. Author

N88-24360# Lawrence Livermore National Lab., Calif.
NUCLEAR SAFETY AS APPLIED TO SPACE POWER REACTOR SYSTEMS
Garth E. Cummings *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 463-467 Previously announced as N87-26623 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

To develop a strategy for incorporating and demonstrating safety, it is necessary to enumerate the unique aspects of space power reactor systems from a safety standpoint. These features must be differentiated from terrestrial nuclear power plants so that experience can be applied properly. Some ideas can then be developed on how safe designs can be achieved so that they are safe and perceived to be safe by the public. These ideas include operating only after achieving a stable orbit, developing an inherently safe design, designing in safety from the start and managing the system development (design) so that it is perceived safe. These and other ideas are explored. Author

N88-24361# Department of Energy, Washington, D. C. Div. of Special Applications.
DEVELOPMENT AND IMPLEMENTATION OF A SPACE NUCLEAR SAFETY PROGRAM
Gary L. Bennett, A. L. Mowery, Jr., James J. Lombardo, C. T. Bradshaw, A. Schock, E. A. Skrabek, B. W. Bartram, R. W. Englehart, D. W. Conn, and J. C. Hagan (Johns Hopkins Univ., Laurel, Md.) et al. *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 469-472 Prepared in cooperation with Los Alamos National Lab., N. Mex. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Safety has been, and must continue to be, an integral part of the design and development of any space nuclear power system. The primary safety objective is to minimize the potential interaction of the radioactive materials with Earth's population and environment. This objective can be met by a combination of system design, operational constraints, and emergency planning. Space nuclear power reactor safety is further explored. Author

N88-24362# Nuclear Utility Services, Inc., Gaithersburg, Md.
INNOVATIVE METHODOLOGY AND DEVELOPMENTS IN US SPACE RADIOISOTOPE POWER SAFETY RISK ASSESSMENTS
R. W. Englehart, B. W. Bartram, H. Firstenberg, R. W. Jubach, and F. R. Vaughan *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 473-475 (For primary document see N88-24254 17-73)
(Contract DE-AC01-83NE-32114)
Avail: NTIS HC A22/MF A01

During the development of the safety information relating to the Galileo and Ulysses deep space missions, the state of safety and risk assessment technology underwent several developments which related to the use of the Space Shuttle as the launch vehicle and the changes in accident considerations which this necessitated. These changes included more detailed understanding of the close-in environments of liquid propellant explosions, analysis techniques to better consider the statistical nature of explosion severities, and to specify source terms appropriate to quantification of risk, use of preliminary risk analyses, and better understanding of explosion environments as input to the design of safety test series. They also included application of new internal dosimetry for Pu-238 dioxide and implementation of a de minimus dose concept for risk considerations. These considerations are further developed herein. Author

N88-24363# Sandia National Labs., Albuquerque, N. Mex.
INHERENTLY SAFE SPACE REACTORS
James Lee, J. C. Cleveland (Oak Ridge National Lab., Tenn.), and Patrick McDaniel *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 477-480 (For primary document see N88-24254 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A22/MF A01

The first attempt to understand the behavior of gas cooled multimegawatt space reactors during a loss of cooling accident is presented. While the presented results are preliminary, the modeling of the reactor behavior during the loss of coolant accident (LOCA) is of sufficient fidelity to indicate that gas cooled space reactors operating in burst mode at hundreds of megawatts thermal for short time periods and in alert mode at steady state power levels of tens of megawatts thermal can be designed inherently for walk away safety. That is, without aid of a separate, emergency cooling system the reactor will not melt during the LOCA.
Author

N88-24364# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
ADVANCED LMMHD SPACE POWER GENERATION CONCEPT **c75**
Vincent Ho, Albert Wong, Kilyoo Kim, and Vijay Dhir *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 481-484 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Magnetohydrodynamic (MHD) power generation concept has been proposed and studied worldwide as one of the future power generation sources. An advanced one fluid two phase liquid metal (LM) MHD power generation concept was developed for space

nuclear power generation design. The concept employs a nozzle to accelerate the liquid metal coolant to an acceptable velocity with Mach number greater than unity. Such nozzle and the MHD power generator replace the turbogenerator of a high temperature Rankine turboelectric cycle concept. As a result, the power generation system contains no movable parts. This provides high reliability, which is a very important factor in space application.
Author

N88-24365# Idaho National Engineering Lab., Idaho Falls.
EXPERT SYSTEMS APPROACH TO MODELING SYSTEMS WITH THE ATHENA THERMAL-HYDRAULICS CODE **c61**
R. K. Fink, R. A. Callow, V. H. Ransom, and T. K. Larson *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 485-488 (For primary document see N88-24254 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A22/MF A01

Preparation of models for a large engineering analysis code is a demanding task in terms of both time and expertise required. Knowledge engineering techniques are a possible way to reduce manpower costs and also improve the utility of engineering analysis tools. The development is described of an expert system to assist analysts in the application of the Advanced Thermal Hydraulic Energy Network Analyzer (ATHENA) computer code. ATHENA, a large FORTRAN based thermal hydraulic systems analysis code, was developed for transient simulation of energy networks such as nuclear reactor systems. The ATHENA code is briefly described and the use of expert systems for preparation of code input and accessing modeling guidelines contained in knowledge bases is addressed. Author

N88-24366# Wisconsin Univ., Madison. Fusion Technology Inst.
SOAR: SPACE ORBITING ADVANCED FUSION POWER REACTOR **c75**
J. F. Santarius, G. L. Kulcinski, H. Attaya, M. L. Corradini, L. A. El-Guebaly, G. A. Emmert, C. W. Maynard, M. E. Sawan, I. N. Sviatoslavsky, and W. F. Vogelsang et al. *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 489-492 Sponsored by the Grainger Foundation and Department of the Air Force, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The Space Orbiting Advanced Fusion Power Reactor (SOAR) is described. The SOAR reactor delivers 250 to 1000 MWe for at least 10 minutes from a D/He-3 plasma. About 99 percent of the fusion energy is in charged particles, and much of this energy is electrostatically converted directly into electricity at high efficiency. Advanced materials and shielding techniques allow SOAR to deliver approx. 1 kw of electricity for every kg of material orbited. The SOAR reactor concept is designed to allow rapid startup and shutdown procedures as well as a frequent restart capability. The lack of radioactivity on launch and the low radioactive inventory after operation make the SOAR concept attractive from both safety and environmental perspectives. Author

N88-24367*# Washington Univ., Seattle. Aerospace and Energetics Research Program.
MULTIMEGAWATT NUCLEAR POWER SYSTEM FOR LUNAR BASE APPLICATIONS
B. Trueblood, R. Pressentin, A. P. Bruckner, and A. Hertzberg *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 493-495 Sponsored by NASA, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01 CSCL 18I

A multimegawatt nuclear power system for lunar surface applications is presented. The design requirements were to produce 3 MWe on the Moon for an operational lifetime of 10 years without human intervention. The system uses an inert-gas-cooled fuel pin reactor as the heat source, a regenerative Brayton cycle as the power converter and a liquid droplet radiator as the thermal management system, and has a specific power of 66 W/kg.
Author

N88-24368# Texas A&M Univ., College Station. Nuclear Science Center.
RADIATION EFFECTS TESTING CAPABILITIES OF THE TEXAS A AND M NUCLEAR SCIENCE CENTER
John L. Krohn *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 497-500 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Testing of systems and subsystems for radiation damage, hardness and survivability has grown in both number and size over the past years. Work was done in the testing of electronic components for radiation hardness and in developing radiation resistant components. Various reactor facilities have participated in this testing, but the Nuclear Science Center Reactor at Texas A and M Univ. offers unique capabilities. The uniqueness of the facility has been demonstrated by several small scale tests conducted over the past few years. The facility offers a flexible radiation testing capability that can provide tailored neutron and gamma ray environments for space reactor experiments that require cryogenic, vacuum or other special environments during the exposure to reactor neutrons and gamma rays. Some of the recent work done at the NSC and some of the facility's unique capabilities are discussed. Author

N88-24369# TRW Space Technology Labs., Redondo Beach, Calif. Space and Technology Group.
A GENERALIZED METHOD FOR OPTIMIZING THE MASS OF SPACE POWER SYSTEMS **c20**
J. K. Garner, T. J. Fitzgerald, and B. B. Glasgow *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 501-504 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

A simple analytic model and a more detailed numeric model for optimizing the radiator temperature of a space power system for minimum system mass was developed. The models are applicable to most space power systems, including large and small nuclear and solar dynamic systems, and have yielded suprisingly accurate results for the cases checked. Both models require component weights as a function of system parameters. Author

N88-24370# Missouri Univ., Rolla.
MODELING OF RADIATION DOSE DEPENDENCE OF MOSFETs **c76**
C. F. Tang, C. H. Wu, and A. Kumar *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 505-507 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Degradations of metal oxide semiconductor (MOS) devices due to their exposure to ionizing radiation are known to be caused by a build-up of positive trapped charge inside the oxide and a generation of interface traps between SiO2 and Si. The amount of the positive charge present and the density of the generated interface trap depend on the radiation dose. A model is presented to describe the dependence of I-V characteristics of MOSFETS on the radiation dosage. Author

N88-24371# Los Alamos National Lab., N. Mex. Materials Science and Technology Div.
FABRICATION OF SP-100 FUEL BARRIER STRUCTURES BY CHEMICAL VAPOR DEPOSITION
David W. Carroll, Stevan G. Pattillo, and David M. Stupin *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 509-512 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

Barrier materials located between the UN fuel and the Nb-1 percent Zr cladding are required in the SP-100 design to prevent

interaction between the fuel and cladding. Fabrication of tungsten fuel barrier components by chemical vapor deposition meeting requirements for the SP-3 test was accomplished and development begun to produce Re fuel liners of the same specification. Longer liners up to 60.9 cm are possible utilizing existing equipment; longer length to 132.0 cm are conceivable with redesigned apparatus and fixturing and a concerted development effort. Examples of these techniques are presented. Author

N88-24372# New Mexico Univ., Albuquerque. Inst. for Space Nuclear Power Studies.
SP-100 SYSTEM MODELING: SNPSAM UPDATE
Mohamed S. El-Genk, Jong T. Seo, and C. Brad Evans *In its* Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 513-516 (For primary document see N88-24254 17-73)
(Contract F29601-84-C-0080)
Avail: NTIS HC A22/MF A01

A Space Nuclear Power System Analysis Model (SNPSAM) was developed to investigate the operating characteristics of the integrated thermoelectric (TE) SP-100. SNPSAM is a modular computer model that takes into account the interactions and feedback processes among the system's major components. This interactively coupled model is capable of predicting the performance of the integrated system during both steady state and transient operations as well as the system's load following characteristics. A two dimensional single fuel rod model and an accumulator model were developed and incorporated into SNPSAM. The single fuel rod model calculates the temperature distributions in the reactor core region as a function of reactor thermal power. Author

N88-24373# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
FABRICATION OF A NIOBIUM 1 PERCENT ZIRCONIUM CONTAINMENT FOR SP-100 PRIMARY LITHIUM SYSTEM MATERIALS MASS TRANSFER STUDIES
Alvin R. Keeton, Chris C. Alexion, and Chris Bagnall *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 517-520 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

The physical properties of lithium make it the leading candidate for a heat transfer fluid in space nuclear power systems. The Nb alloy, Nb-1 percent Zr, was developed for containment of lithium at high temperature. SDI has rekindled interest in Li cooled compact nuclear reactors, and Nb-1 percent Zr was selected as the primary containment material for lithium in the SP-100 program. In order to maintain and advance the technology necessary to fabricate and operate refractory metal alloy or lithium systems, Westinghouse has designed and constructed a Nb-1Zr/Li test loop. The steps and techniques employed for this project are described and the proposed test program and its objectives are outlined. Author

N88-24374# New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
TRANSACTIONS OF THE FIFTH SYMPOSIUM ON SPACE NUCLEAR POWER SYSTEMS
Mohamed S. El-Genk, ed. and Mark D. Hoover, ed. (Lovelace Inhalation Toxicology Research Inst., Albuquerque, N. Mex.) 1988 611 p Symposium held in Albuquerque, N. Mex., 11-14 Jan. 1988; co-sponsored by American Inst. of Chemical Engineers, American Society of Mechanical Engineers, GE Co., LANL, Sandia National Labs., AFSTC, American Nuclear Society and ASTM
(DE88-006165; CONF-880122-Summs) Avail: NTIS HC A99/MF A01

The Fifth Symposium on Space Nuclear Power Systems took place in Albuquerque, New Mexico, on January 11 to 14, 1988. It was the fifth in an annual series of symposia sponsored principally by the University of New Mexico and the New Mexico technical community, and included Federal government, industrial, national laboratory, and university participants. The past year had seen continued technical and programmatic successes in the SP-100 Space Power Reactor and Multimegawatt Space Nuclear Power programs. With the Space Shuttle to fly again in 1988, more attention can be devoted to developing the technology needed for future long duration space travel. Safe, reliable space nuclear power systems are essential for the success of these missions. Reports of symposium participants follow. For individual titles, see N88-24375 through N88-24506.

N88-24375# Westinghouse Hanford Co., Richland, Wash.
SP-100 GES TEST SITE Abstract Only
Carl M. Cox, Michael K. Mahaffey, and William C. Miller *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 3-4 (For primary document see N88-24374 17-73)
(Contract DE-AC06-87RL-10930)
Avail: NTIS HC A99/MF A01

A performance test of a full-scale, prototypic nuclear subsystem of a 100 kWe space nuclear power supply is planned for 1992. This Nuclear Assembly Test will be conducted at the SP-100 Test Site, located at the Department of Energy's Hanford facilities near Richland, Washington. In addition to the reactor, supplied by General Electric, the Test Site will consist of 35 major systems which will simulate a space environment, protect the reactor and the surrounding environment during normal and off-normal operation, and provide control and data gathering functions. These systems include a large vacuum chamber to house the reactor, a containment isolation system, a control system, a secondary heat transport system, and other support systems. Author

N88-24376# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CIVIL MISSIONS APPLICATIONS STUDY c12
John Carlton Mankins and Jerry Olivieri *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 5-8 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

This study collects and categorizes a forecast of ambitious civilian space missions; it also assesses their requirements for power and the application of space nuclear power systems to meet these needs. Although the results of this 1986 study have been recast to reflect recent NASA planning (Ride's Bold New Initiatives), the basic mission and power requirements forecast remain essentially the same. Civil mission applications have been organized into four major areas with one additional topic: (1) Earth orbiting missions (including Space Stations, Earth Observing Missions, and materials processing); (2) Planetary exploration; (3) Manned lunar base; and (4) Manned Mars Mission; plus (5) Extra-solar spacecraft (i.e., the Thousand AU explorer concept). Author

N88-24377*# Science Applications International Corp., Schaumberg, Ill.
APPLICATIONS OF NUCLEAR POWER TO LUNAR AND MARS MISSIONS
Alan Friedlander and Kevin Cole *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 9-12 Sponsored by NASA, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 18I

The initial elements of an ambitious program for human exploration beyond Earth have been developed and presented to NASA management for its consideration. The Outpost on the Moon and Humans to Mars are two key U.S. programs (Ride 1987). A major space goal of this magnitude can only be implemented by a series of program phases evolving from precursor robotic missions, to initial development of temporary surface stations and buildup of operational experience, through the eventual establishment of permanent and sustained surface bases. Each phase of the separate (or linked) lunar and Mars scenarios will require distinctly different levels and types of power sources to support both transportation and on-surface operations, i.e., the nuclear power reactor. Discussed are the respective types and

specific amounts of power required for all major systems in a phased program of lunar and Mars exploration over the period 1990 to 2040. A comparative assessment of technology tradeoffs and special design problems is made to ascertain the most appropriate application for the different phases, as well as to identify synergistic developments across the programs. Author

N88-24378# Air Force Weapons Lab., Kirtland AFB, N. Mex.
AIR FORCE SPACE POWER REQUIREMENTS AND NUCLEAR POWER ASSESSMENT METHODOLOGY
David R. Boyle and Michael G. Jacox *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 15-18 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

All Air Force spacecraft, existing and planned, require an electric power supply. As the Air Force space missions expand and the operational requirements increase, so too the demand for electric power continues to grow. Space power subsystems are often viewed as a low priority in spacecraft development; frequently, developers assume that something will surely be available to provide the needed power. However, increased power levels and other requirements on space systems are forcing developers to take a serious look at space power. This paper provides the space power development community with an unclassified review of projected space power requirements and trends and an insight into how competing power subsystems will be assessed by the Air Force. Author

N88-24379# Idaho National Engineering Lab., Idaho Falls.
COMPARISON OF A DIRECT THRUST NUCLEAR ENGINE, NUCLEAR ELECTRIC ENGINE AND A CHEMICAL ENGINE FOR FUTURE SPACE MISSIONS **c20**
Jack H. Ramsthaler and Tal K. Sulmeisters (Martin Marietta Corp., Englewood, Colo.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 19-22 (For primary document see N88-24374 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A99/MF A01

The need for an advanced direct thrust nuclear rocket propulsion engine was identified in Project Forecast 2, Air Force Systems Command report on its future needs. The AF Astronomical Lab (AFAL) has the responsibility to develop the nuclear engine. The Idaho National Engineering Lab (INEL) will collaborate with Martin Marietta to stage design and mission analyses. Science Applications International (SAIC) will do flight safety analysis. Westinghouse will design the nuclear subsystem, and Rocketdyne the engine. INEL is overall manager for program and test facility design, construction and operation. INEL has produced plans for both engine system and ground test facility. AFAL has funded INEL to perform mission analyses and to evaluate cost, performance and operational advantages for a direct thrust nuclear rocket stage in performing AF Space missions. The Advanced Nuclear Rocket Engine (ANRE), a scaled down NERVA derivative, was used as a baseline for comparison with chemical engines and nuclear electric engines for completion of orbital transfer and maneuver missions. Life cycle costs of the three systems are estimated, based on delivery of a 6350 kg payload from LEO to geosynchronous orbit and back to LEO. Author

N88-24380# Los Alamos National Lab., N. Mex.
NUCLEAR-POWERED SPACE DEBRIS SWEEPER **c18**
John D. Metzger, Steven D. Howe, Rene J. LeClaire, Jr., and Karen C. Burgin *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 23-27 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Future spacecraft design will be affected by collisions with man-made debris orbiting the Earth. Most of this orbital space debris comes from spent rocket stages. It is projected that the source of future debris will be the result of fragmentation of large objects through hypervelocity collisions. Orbiting spacecraft will have to be protected from hypervelocity debris in orbit. The options are to armor the spacecraft, resulting in increased mass, or actively removing the debris from orbit. An active space debris sweeper is described which will utilize momentum transfer to the debris through laser-induced ablation to alter its orbital parameters to reduce orbital lifetime with eventual entry into the Earth's atmosphere where it will burn. The paper describes the concept, estimates the amount of velocity change (Delta V) that can be imparted to an object through laser-induced ablation, and investigates the use of a neutral particle beam for the momentum transfer. The space sweeper concept could also be extended to provide a collision avoidance system for the space station and satellites, or could be used for collision protection during interplanetary travel. Author

N88-24381# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
EETAP (END-TO-END TRANSIENT ANALYSIS PROGRAM) FOR SPACE NUCLEAR POWER SYSTEM SIMULATION
Michael Gaeta, Vladimir Djordjevic, David Carpenter, Paul Brohlin, James Hansen, Frederick Best, Carl Erdman, and Mehrdad Ehsani *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 29-32 Sponsored by General Electric Co., Fairfield, Conn. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

EETAP (End-to-End Transient Analysis Program) is a computer code that simulates the transient and steady state operation of a space reactor power system from the reactor thermal power source to the user electrical output. EETAP was used to model a general space reactor power system which included a liquid metal cooled fast reactor, primary and secondary loops, thermoelectric electromagnetic self induced pumps, thermoelectric generators, power conditioning module, and heat pipe radiators. An advantage of this code is its relatively short run time and its ability to be used on a personal computer. EETAP can be used to study accidents such as the effect of a pump or radiator panel failure or the effect of an inadvertent reactor shutdown and subsequent restart. Author

N88-24382# Energy Technology Engineering Center, Canoga Park, Calif.
OPTIMIZATION OF SP-100 THERMOELECTRIC ELECTROMAGNETIC PUMP **c37**
J. M. Berreth and D. L. Wait *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 33-36 Sponsored by Los Alamos National Lab., N. Mex. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

In the SP-100 space nuclear power concept, thermoelectric elements (TE) directly convert some 2 MWt of thermal power generated by a fast flux nuclear reactor to 100 kWe of electrical power. Thermoelectric electromagnetic (TEM) pumps with self-induced magnets circulate liquid lithium to transfer heat from the reactor to the thermoelectric elements. Author

N88-24383# Texas Technological Univ., Lubbock. Dept. of Industrial Engineering.
RELATING DESIGN AND ENVIRONMENTAL VARIABLES TO RELIABILITY
William J. Kolarik and Thomas L. Landers (Arkansas Univ., Fayetteville.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 37-40 (For primary document see N88-24374 17-73)
(Contract DNA001-85-C-0184)
Avail: NTIS HC A99/MF A01

The combination of space application and nuclear power source demands high reliability hardware. The possibilities of failure, either an inability to provide power or a catastrophic accident, must be minimized. Nuclear power experiences on the ground have led to highly sophisticated probabilistic risk assessment procedures, most of which require quantitative information to adequately assess such risks. In the area of hardware risk analysis, reliability information plays a key role. One of the lessons learned from the Three Mile

Island experience is that thorough analyses of critical components are essential. Nuclear grade equipment shows some reliability advantages over commercial. However, no statistically significant difference has been found. A recent study pertaining to spacecraft electronics reliability, examined some 2500 malfunctions on more than 300 aircraft. The study classified the equipment failures into seven general categories. Design deficiencies and lack of environmental protection accounted for about half of all failures. Within each class, limited reliability modeling was performed using a Weibull failure model. Author

N88-24384# Argonne National Lab., Ill.
THERMAL AND POWER AVAILABILITY TRANSIENT RESPONSES FOR THE ARGONNE MONOLITHIC SOLID OXIDE FUEL CELL **c44**
Nelson A. Hanan and Larry W. Carlson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 41-44 Sponsored by Strategic Defense Initiative Organization, Washington, D.C., DOE, Washington, D.C. and Defense Advanced Research Projects Agency, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The Monolithic solid oxide fuel cell (SOFC) is a candidate electric power source for space applications which require multimegawatts within short startup times. In a previous systems study, an SOFC was coupled to a nuclear Rankine cycle to provide both long term housekeeping power, short term alert power, and shorter term burst power. Waste heat from the nuclear system was used to maintain the SOFC components at an elevated initial temperature. Despite this provision, it was not known whether the SOFC would provide required power levels within the especially short time frame demanded by the application. A finite difference transient thermal analysis, coupled with the electrochemical equations, was done using the Dusinberre methodology. The Argonne Monolithic fuel cell construction consists of a corrugated sandwich of anode, electrolyte, and cathode elements alternating with a sandwich of anode, interconnection, and cathode materials in a multilayer structure. Electrical potential develops across the anode-electrolyte-cathode sandwich and builds in the layered direction. The interconnection material permits electron transport, but blocks oxygen ion back diffusion, which otherwise would short out the cell. Author

N88-24385*# Sandia National Labs., Albuquerque, N. Mex. Advanced Power Systems Div.
HYDROGEN TURBINES FOR SPACE POWER SYSTEMS: A SIMPLIFIED AXIAL FLOW GAS TURBINE MODEL **c37**
Steven L. Hudson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 45-49 Sponsored by NASA, Lewis Research Center, Cleveland, Ohio (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01 CSCL 13I

Hydrogen cooled, turbine powered space weapon systems require a relatively simple, but reasonably accurate hydrogen gas expansion turbine model. Such a simplified turbine model would require little computational time and allow incorporation into system level computer programs while providing reasonably accurate volume/mass estimates. This model would then allow optimization studies to be performed on multiparameter space power systems and provide improved turbine mass and size estimates for the various operating conditions (when compared to empirical and power law approaches). An axial flow gas expansion turbine model was developed for these reasons and is in use as a comparative bench mark in space power system studies at Sandia. The turbine model is based on fluid dynamic, thermodynamic, and material strength considerations, but is considered simplified because it does not account for design details such as boundary layer effects, shock waves, turbulence, stress concentrations, and seal leakage. Although the basic principles presented here apply to any gas or vapor axial flow turbine, hydrogen turbines are discussed because of their immense importance on space burst power platforms. Author

N88-24386# Brookhaven National Lab., Upton, N. Y.
THEORETICAL PREDICTION OF SINGLE PHASE TURBULENT FLOW DISTRIBUTION IN PARTICULATE BED REACTORS **c34**
Robert F. Benenati and Fredrick L. Horn *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 51-54 (For primary document see N88-24374 17-73)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC A99/MF A01

The particulate bed reactor is best characterized as a collection of shallow radial particle beds with axial flow inlet and outlet ducts. Although flow could be radially inward or radially outward, the preferred system involves radial inflow because this confines the hot coolant gas by the flue bed itself and eases some of the mechanical problems. Particulate beds are customarily treated as homogeneous although bed voidage is only approximately uniform throughout any given bed. For many applications to space technology, it is highly desirable for the coolant gas to exit the reactor at a uniform temperature. This creates a 3-D flow distribution problem, exacerbated by the usual flux buckling common to nuclear reactors and further exacerbated by the fact that the axial component of the exiting coolant flow imposes a dynamic pressure effect which under some circumstances strongly influences the radial flow through the bed. To achieve a flow distribution that assures the design objectives and adequately addresses hot spot problems is therefore a formidable task. Author

N88-24387*# New Mexico Univ., Albuquerque. Technology Application Center.
REVIEW OF POWER REQUIREMENTS FOR SATELLITE REMOTE SENSING SYSTEMS **c18**
Stanley A. Morain *In its* Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 55-63 (For primary document see N88-24374 17-73)
(Contract NASw-4191)
Avail: NTIS HC A99/MF A01 CSCL 22B

The space environment offers a multitude of attributes and opportunities to be used to enhance human life styles and qualities of life for all future generations, worldwide. Among the prospects having immense social as well as economic benefits are earth-observing systems capable of providing near real-time data in such areas as food and fiber production, marine fisheries, ecosystem monitoring, disaster assessment, and global environmental exchanges. The era of Space Station, the Shuttle program, the planned unmanned satellites in both high and low Earth orbit will transfer to operational status what, until now, has been largely research and development proof of concept for remotely sensing Earth's natural and cultural resources. An important aspect of this operational status focuses on the orbital designs and power requirements needed to optimally sense any of these important areas. Author

N88-24388*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTROMAGNETIC POWERED VEHICLES (EMPV) FOR MARS EXPLORATION **c20**
Jose L. Christian, Jr. and Ira T. Myers *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 67-70 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 21H

Special attention has been given to manned missions to the Moon and Mars not only for exploration, but to establish permanent manned outposts. In order to fulfill such ambitious plans, it is necessary to establish technology bases in the areas of transportation, robotics, life support, and power generation. In the latter area, major progress has been made in solar dynamics, photovoltaics, heat cycle engines, thermionics, and nuclear space power generation. At the level of the present technology, massive structures are required for power generation, cooling, and shielding. The great mass of these systems will hinder a manned mission from obtaining a reasonable mobility over a planetary surface. For

planetary exploration, small wheeled vehicles driven by batteries or fuel cells have been proposed, although other types such as solar or nuclear powered could potentially be used. Author

N88-24389*# Ad Astra Ltd., Santa Fe, N. Mex.
POWER REQUIREMENTS FOR MINING AND MICROWAVE PROCESSING OF EXTRATERRESTRIAL RESOURCES
Raymond S. Leonard and Stewart W. Johnson (BDM Corp., Albuquerque, N. Mex.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 71-75 Sponsored in part by NASA, Lyndon B. Johnson Space Center, Houston, Tex. and Los Alamos National Lab., N. Mex. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 18I

Research in progress on the use of nuclear power in mining the Martian moons for volatiles and hydrocarbons as well as to power microwave generators for processing both lunar regolith and the spoils from the Martian mines into building materials is described. Previous work on mining the Martian moons developed estimates for the costs and power requirements for extracting and shipping any volatiles that might be found on Phobos and Diemos. The costs were compared to the cost of shipping the same volatiles from Earth and it was found that the mining operation would break even for launch costs from Earth as low as ninety dollars per pound (198 dollars/kg). Above this figure the mines would generate a profit. Based on the results of recent work on the microwave processing of lunar regolith it was decided to refine the concept description. Work under way and to be reported deals with a better definition of the power required for mine operations, nuclear propulsion, and microwave materials processing. Author

N88-24390*# Wisconsin Univ., Madison. Fusion Technology Inst.
ENERGY REQUIREMENTS FOR HE-3 MINING OPERATIONS ON THE MOON
Gerald L. Kulcinski *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 77-80 Sponsored by NASA, Washington, D.C., the Grainger Foundation and Wisconsin Univ., Madison (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 18L

At the present rate of world energy consumption (10 TW-y/y) and allowing for an equilibrium consumption of 20 to 30 TW-y/y in mid 21st century, we will exhaust economically recoverable fossil fuels in the next 50 to 60 years. We will then have to rely on nuclear (fission and fusion) and renewable energy to feed, warm, and protect the world's population. Fusion energy is expected to play an important role in the 21st century and there a 2 billion dollar per year research program to commercialize that energy resource. A serious problem with this is its reliance on the D-T fuel cycle which releases 80 percent of its energy in the form of neutrons. These neutrons cause significant radiation damage and induce large amounts of radioactivity. There is another fusion fuel cycle involving the isotopes of Deuterium and Helium-3 which, if configured properly, releases 1 percent or less of its energy in neutrons. Obviously, such a fuel would be preferred, but there is no large source of He-3 known to satisfy world energy needs. Fortunately, a very large source of He-3 was found on the Moon, implanted over the past 4 billion years by the solar wind. Recent analysis of Apollo and Luna data reveals that over a million tons of He-3 sit on the Moon's surface. The potential energy in this He-3 fuel is 10 times that contained in all the coal, oil, and natural gas on the Earth. The purpose of this paper is to examine the energy required to extract the He-3 from the lunar regolith.

Author

N88-24391# Argonne National Lab., Ill.
POWER AND ENERGY REQUIREMENTS FOR ELECTROMAGNETIC LAUNCHERS **c33**
P. A. Lottes, R. E. Holtz, and K. L. Uherka *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 81-84 (For primary document see N88-24374 17-73)
(Contract W-31-109-eng-38)
Avail: NTIS HC A99/MF A01

A large data base exists covering almost all aspects of the requirements for the successful development of electromagnetic launchers. To extend the use of electromagnetic launchers to the limits of technology for such exotic applications as hypervelocity weaponry or space launch systems, it is useful to examine the energy and power requirements for such uses. One way to do this is to purposely neglect all system losses in order to determine minimum power and energy requirements. Actual power requirements will most likely be higher by at least a factor of three. Calculations are presented for minimum power requirements, launch acceleration time, projectile kinetic energy, and projectile inertial force as a function of projectile mass, projectile terminal velocity, and the length of the launch tube. Results of these calculations are presented. Author

N88-24392# Los Alamos National Lab., N. Mex.
INDIVIDUAL SATELLITE POWER REQUIREMENTS CALCULATED FROM SPECIFIED CONSTELLATION PERFORMANCE **c18**
Duane R. Marr, Russell B. Kidman, and W. Greg Lacey *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 85-88 Sponsored by DOE, Washington, D.C. and DOD, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The development of individual station power requirements in a space-based SDI system needs to be made in the context of the defensive effectiveness of the system as a whole, and not on the maximum effectiveness of the individual platform. It is possible, for instance, that a few platforms with high effectiveness might be a less cost effective way to achieve a given level of performance than a larger number of platforms, each with a lesser effectiveness. In order to make a tradeoff study, one needs to calculate the performance of the defensive system as a whole. Further, total system power is important because it is a major determinant of the launch resources required. An evaluation of the resource requirements for such a system thus requires a knowledge not only of the individual station power but also of the number of platforms. These are just two of the problems that the computer program DEFENSE can help solve. DEFENSE is a computer simulation of the engagement of a space-based SDI defense against an offensive threat containing hundreds of thousands of objects. Given the characteristics of a defensive platform and the number of such platforms, DEFENSE calculates the performance of the system as a whole. It can thus be used to determine the size of (numbers in) the constellation required for a given level of performance. It can also help optimize the system through the use of tradeoff studies. Author

N88-24393# California Univ., Los Angeles. Dept. of Mechanical Aerospace and Nuclear Engineering.
DEVELOPMENT OF A LIGHTWEIGHT STRUCTURE WITH LOAD BEARING CAPABILITY AND HIGH THERMAL CONDUCTANCE **c18**
Vu X. Tung and Vijay K. Dhir *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 89-92 Sponsored by Innovative Nuclear Space Power Inst. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

In high power radiator applications for space systems, heat pipes are employed to transfer heat over long distances with relatively small temperature gradients. However, there also exists a need for a complimentary structure in which heat is transported between two surfaces separated by a relatively short distance. The structure must have load bearing capability and high thermal conductance in both in-plane and transverse directions. Such a structure thus can serve the multiple function of temperature control, isothermal mounting base for equipment modules, and primary structure radiator panels. It can also be used as high efficiency radiator fins with direct heat pipe interface or as coupling

elements in thermionic reactors. A structure with load bearing capability and high thermal conductance is developed using transport of latent heat similar to that employed in heat pipes. The structure consists of porous wicks bonded to the two surfaces and a wickable core which provides liquid coupling between the two surfaces as well as load bearing capability. Author

N88-24394# Pacific Northwest Labs., Richland, Wash.
A REFLUX TUBE FABRIC RADIATOR **c34**
Edmund P. Coomes and Joseph M. Kelly *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 93-97 (For primary document see N88-24374 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A99/MF A01

An alternative heat rejection system is possible that will meet survivability criteria while greatly enhancing space nuclear power systems. This alternative radiator design, the reflux tube fabric radiator, uses light weight high strength fabric materials, relies on an induced artificial gravity, and builds on the long established technologies associated with reflux tubes and thermosyphons, the predecessors of the modern microgravity heat pipe. The various types of heat pipes developed to date fall into two basic categories: (1) gravity return thermosyphons and reflux tubes; and (2) capillary return heat pipes. NASA Lewis Research Center developed a rotating wickless heat pipe that was rotated about its longitudinal centerline using centrifugal acceleration instead of capillary action or gravity to return condensate. With this single exception, thermosyphons and reflux tubes have always been considered unsuitable for space flight applications because they require a gravitational field for fluid return. Author

N88-24395*# Sverdrup Technology, Inc., Cleveland, Ohio.
THE LEWIS HEAT PIPE CODE WITH APPLICATION TO SP-100 GES HEAT PIPES **c34**
Karl W. Baker and Leonard K. Tower *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 99-103 Sponsored by NASA, Lewis Research Center, Cleveland, Ohio (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 20D

The NASA Lewis Research Center has a thermal management program supporting SP-100 goals, which includes heat pipe radiator development. As a part of the program Lewis has elected to prepare an in-house heat pipe code tailored to the needs of its SP-100 staff to supplement codes from other sources. The latter, designed to meet the needs of the originating organizations, were deemed not entirely appropriate for use at Lewis. However, a review of their features proved most beneficial in the design of the Lewis code. Author

N88-24396# Los Alamos National Lab., N. Mex.
HTPIPE: A STEADY STATE HEAT PIPE ANALYSIS PROGRAM **c34**
Keith A. Woloshun and Michael A. Merrigan *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 105-108 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

A steady state heat pipe analysis computer program has been developed as an aid in the design of high performance heat pipes. The program is the result of a major revision of a previous version used at Los Alamos National Laboratory (LANL), which calculated the capillary, sonic, and entrainment performance limits, as well as pressure and temperature profiles for a specified power throughput and evaporator exit temperature. Program modifications include changes in the entrainment limit calculations to reflect recent developments, a change in the condensor pressure recovery prediction at high radial Reynolds number, and boiling limit calculations. The program has also been expanded to calculate temperature and pressure profiles based on the specification of any two of four design parameters. Power throughput, evaporator exit temperature, source temperature and sink temperature. Heat input and removal is assumed to be uniform over the length of the evaporator and the condenser, respectively, unless source and/or sink conditions are specified. In this case, local heat input and/or removal is determined by the local temperature gradient and the thermal coupling, which may be convective or radiative. Author

N88-24397# Pacific Northwest Labs., Richland, Wash.
HEAT PIPE TRANSIENT ANALYSIS: VAPOR DYNAMICS **c34**
Joseph M. Kelly *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 109-113 Previously announced as N88-20568 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

A multidimensional model for the analysis of heat pipe transients (HPTRAN) is being developed. The cornerstone of this model is a new partially implicit numerical algorithm for two phase flow. Time steps far in excess of the Courant limit (CFL number of 100 to 200) are allowed, without the computational burden per time step that accompanies a fully implicit treatment. The resulting computational efficiency renders transient multidimensional analysis practicable. This paper provides a brief description of the numerical method and presents the results of initial data comparisons. Bowman (1987) performed a series of experiments to investigate heat pipe vapor dynamics using a porous tube with blowing/suction. These tests were simulated using both distributed (2-D) and lumped (1-D) parameter models. Stable solutions were obtained using large time steps for a wide range of Reynolds (5x10 to the 10th) and Mach (0.1 to 1.0) numbers. Good data comparisons were achieved, with the multidimensional model outperforming the one-dimensional model. Areas for future improvements were identified in both the turbulence model and the finite difference form of the momentum flux terms. Author

N88-24398# New Mexico Univ., Albuquerque. Inst. for Space Nuclear Power Studies.
A TRANSIENT MODEL FOR LIQUID METAL HEAT PIPES **c34**
Jong T. Seo and Mohamed S. El-Genk *In its* Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 114-119 (For primary document see N88-24374 17-73)
(Contract F29601-84-C-0080)
Avail: NTIS HC A99/MF A01

A transient model for the liquid metal heat pipe is developed and model predictions compared with cooldown data for the lithium heat pipe. The advantages of this model over previous models include: incorporating temperature dependent thermophysical properties, treating various combinations of boundary conditions at the evaporator and the condensor regions, and predicting the operation limits of the heat pipes during both steady state and transient operation. The model predictions of the temperatures as well as the cooldown time of the lithium heat pipe with radiative boundary conditions were in good agreement with experimental data. Based on the results of this comparison, it is concluded that the model can provide accurate predictions of the transient performance of high temperature liquid metal heat pipes. However, further comparison of the model with transient data, whenever available, is highly recommended. Author

N88-24399# Los Alamos National Lab., N. Mex.
THE THROHPUT CODE: THERMOHYDRAULIC HEAT PIPE MODELING **c34**
Michael L. Hall and Joseph M. Doster (North Carolina State Univ., Raleigh.) *In its* Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 121-126 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The THROHPUT code is a special purpose transient thermodynamic model of high temperature liquid-metal heat pipe response (THROHPUT is an acronym for Thermal Hydraulic Response Of Heat Pipes Under Transients). A special purpose code like THROHPUT is needed due to the complex nature and

interconection of the physical processes occurring in the operation of a heat pipe with the working fluid partially frozen, such as is the case during the startup, shutdown, and subsequent restart of a lithium filled heat pipe. This paper discusses the modeling strategy which enables THROHPUT to deal with radial and axial melt fronts, capillary forces, and near vacuum operating conditions accurately and effectively. Author

N88-24400# Department of Energy, Washington, D. C. Office of Special Applications.
THE DYNAMIC ISOTOPE POWER SYSTEM: TECHNOLOGY STATUS AND DEMONSTRATION PROGRAM
Gary L. Bennett and James J. Lombardo (North Carolina State Univ., Raleigh.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 127-130 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Dynamic Isotope Systems (DIPS) provide the means for meeting power requirements in the 1- to 10-kWe range. This paper summarizes the technology status and the planned demonstration program for DIPS. The use of dynamic conversion systems with isotope heat sources dates back to SNAP-1 in the 1950s. Since then, various concepts have evolved leading to a DOE-sponsored experimental study in the mid-1970s of Brayton and organic Rankine conversion cycles. Both conversion cycles offer the potential of meeting the next regime of spacecraft power of 1 to 10 kWe. Author

N88-24401# Garrett Fluid Systems Co., Tempe, Ariz.
CHARACTERISTICS OF THE CLOSED BRAYTON CYCLE FOR DYNAMIC ISOTOPE POWER SYSTEMS **c44**
Bradley C. Litz *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 131-134 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The objective of the Department of Energy Dynamic Isotope Power System (DIPS) program is to develop and demonstrate the hardware required to provide a dynamic conversion electrical power system for space applications. Thermal energy for the system is to be obtained from the decay of Plutonium-238. Electric power levels for DIPS range from 1 to 10 kilowatts with 6 kW selected for the demonstration unit. The development of gas bearings and integral brushless alternators that allow complete hermetic sealing of the gas loop has made implementation of the closed Brayton cycle (CBC) attractive for space power use. This technology is supported by 45 years of heat exchanger experience, 35 years of turbomachinery experience, and 25 years of CBC space power system development at Garrett. Operational flexibility is a hallmark of CBC systems, allowing a variety of operating modes and power levels from any given system. Ease of control and simplicity of design provide systems with high reliability and long operational life. Author

N88-24402# Sundstrand Corp., Rockford, Ill.
STATUS OF THE ORGANIC RANKINE CYCLE FOR SPACE APPLICATIONS **c44**
T. J. Bland, P. D. Lacey, and G. L. Sorensen *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 135-138 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The Organic Rankine Cycle (ORC) has been under continuous development and evaluation since the 1960s for both terrestrial and space power applications. Recent activities (Bland et al, 1987) have focused primarily on the Space Station's solar dynamic power system and Dynamic Isotope Power Systems (DIPS) applications. This paper addresses ORC-DIPS system level trade studies conducted during the past year and a half. Two companion papers (Bland and Pearson) present more detailed data on specific ORC-DIPS technology issues and testing conducted during the same period. Author

N88-24403# General Electric Co., Philadelphia, Pa.
STATUS OF MODULAR RTG TECHNOLOGY
Robert F. Hartman *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 139-143 Sponsored by DOE, Washington, D.C., Fairchild Industries, Germantown, Md., ORNL, Tenn. and General Electric Corporate Research Center, Fairfield, Conn. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Radioisotope thermoelectric generators (RTGs) have been employed safely and reliably since 1961 to provide spacecraft electrical power for various NASA and Department of Defense missions. Historically, RTG development, fabrication and qualification have been performed under the sponsorship of the Department of Energy's Office of Special Nuclear Projects and its predecessor groups. RTG technology improvement programs have been conducted over the years by the DOE to improve RTG efficiency and operating performance. The modular RTG design concept resulted from such a program and is currently being developed by the General Electric Company for the DOE. Author

N88-24404# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
POSSIBLE CREEP STUDIES OF LITHIUM WITH A COMPACT DEVICE
Marc-Emmanuel G. Portal and Kenneth L. Peddicord *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 145-148 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

For the first startup of an SP-100 class reactor, the lithium coolant must be thawed. During this thawing, the walls of the reactor will be stressed due to thermal expansion of the liquid metal. To analyze thoroughly the stresses transmitted, creep properties of lithium are needed (Magee et al, 1985). Little mechanical data are available due to difficulties associated with conducting an experiment on lithium near its melting point. A compact apparatus has been designed and tested for a comparable experiment. Author

N88-24405# Missouri Univ., Columbia. Nuclear Engineering Program.
NEUTRONICS CONCEPTUAL DESIGN OF A UF6-FUELED GASESOUS LASER SYSTEM **c36**
Guo-Xiang Gu, Jay F. Kunze, Frederick P. Boody, and Mark A. Prelas *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 149-152 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Using uranium hexafluoride gas to power a reactor core has been proposed previously. Considerable work was done on this concept both as basic reactor (core) physics relating to gaseous core reactors (Kunze 1969) and as an optical pumping source to drive another laser medium (Boody 1978). The first of these studies was aimed primarily at the nuclear propulsion application for space vehicles. However, the necessary core and reflector design differed substantially from the configuration required for the flashlamp driven laser application. This paper examines the specific results of the reactor physics design for the latter concept. Also briefly examined is the reactor physics of a direct UF6 laser, although the feasibility of the laser physics of this direct application has not been seriously examined. Author

N88-24406# New Mexico Univ., Albuquerque. Inst. for Space Nuclear Power Studies.
PRELIMINARY ANALYSIS OF HELIUM GENERATION AND ITS EFFECTS ON THE SP-100 SYSTEM PERFORMANCE
Jong T. Seo and Mohamed S. El-Genk *In its* Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 153-157 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The generation of helium gas in the SP-100 system's primary

coolant loops can be effectively reduced through the use of a lithium coolant with a low abundance of Lithium-6 (less than or = 0.1 percent). Results show that, although the helium gas accumulation in the primary coolant loops only minimally affects the system's electric power output, it degrades the TE-EM pump operation and causes an increase in both coolant and fuel temperatures. If a lithium coolant with an abundance of Lithium-6 greater than 1 percent is used, the helium gas must be removed from the primary loop to avoid saturating the accumulators and overpressurizing the primary coolant loop. Even with a low abundance of Lithium-6, the accumulation of helium gas and the possibility of small bubbles coalescing to form larger bubbles might cause a gas lock in the pipings and, hence, initiate a loss of flow event. For higher system reliability, even though gas separators are employed, it is strongly recommended that lithium coolant with low abundance of Lithium-6 be used. This, however, would require developing a dedicated lithium enrichment facility to meet the national space power program's growing demand for highly depleted lithium. The cost of such a facility would be more than justified by the enhanced system's reliability and safety. Author

N88-24407*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
OPTIMIZATION OF ORGANIC RANKINE CYCLES FOR SPACE STATION APPLICATIONS **c44**
Dana L. Eubanks, Frederick R. Best (Texas A&M Univ., College Station.), and Nanette Faget *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 159-162 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 10B

The purpose of the current program is to investigate the tradeoffs between solar dynamic and nuclear powered systems for the space station. This research is based on a typical Rankine cycle using toluene as the working fluid. The first objective is to produce an adequate thermodynamic cycle model and calculate its efficiency. The next step is to implement a sizing algorithm that calculates the capacity of the various elements of the system, such as the radiator and regenerator, for a given electrical output. Then, the mass of each component must be calculated to give the overall total system mass. Likewise, the space for each component can be determined, giving an estimate of what volume must be available to place the system into orbit. Author

N88-24408# Oak Ridge National Lab., Tenn.
ENHANCED EMITTANCE OF OXIDIZED 304 STAINLESS STEEL **c26**
R. E. Pawel, D. L. McElroy, R. S. Graves, and J. J. Campbell *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 163-166 (For primary document see N88-24374 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A99/MF A01

In order to develop techniques for producing a high-emissivity surface on stainless steel at elevated temperatures, a series of preliminary tests and measurements were performed using a Jones stainless steel (in as-rolled condition) as the primary basis material. Best results seem to be achieved when the oxidation is carried out at temperatures from 1173 to 1373 K for times sufficient to produce a continuous film exhibiting constant emittance values. In addition, the films are adherent and resist abrasion and spallation. Author

N88-24409*# Oregon State Univ., Corvallis. Dept. of Nuclear Engineering.
ASSESSMENT OF NUCLEAR REACTOR CONCEPTS FOR LOW POWER SPACE APPLICATIONS
Andrew C. Klein, Stephen R. Gedeon, and Dennis C. Morey *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 167-170 (For primary document see N88-24374 17-73)
(Grant NAG3-752)
Avail: NTIS HC A99/MF A01 CSCL 18I

The results of a preliminary small reactor concepts feasibility and safety evaluation designed to provide a first order validation of the nuclear feasibility and safety of six small reactor concepts are given. These small reactor concepts have potential space applications for missions in the 1 to 20 kWe power output range. It was concluded that low power concepts are available from the U.S. nuclear industry that have the potential for meeting both the operational and launch safety space mission requirements. However, each design has its uncertainties, and further work is required. The reactor concepts must be mated to a power conversion technology that can offer safe and reliable operation. Author

N88-24410*# Department of Energy, Washington, D. C.
UNITED NATIONS DELIBERATIONS OF THE USE OF NUCLEAR POWER SOURCES IN SPACE: 1978-1987 **c84**
Gary L. Bennett, Joseph A. Sholtis, Jr., and Bruce C. Rashkow (State Dept., Washington, D. C.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 171-175 Sponsored by NASA, Washington, D.C. and DOD, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 05D

The United Nations (U.N.) is continuing its deliberations on the use of nuclear power sources (NPS) in space. Although no complete set of legal principles has yet been agreed upon, certain scientific and technical criteria for the safe design and use of NPS have been accepted. In this respect, it should be noted that in its 1981 report, the Working Group on the Use of Power Sources in Outer Space concluded that power sources can be used safely in outer space, provided that all necessary safety requirements are met. This is also a succinct statement of the U.S. position. Author

N88-24411# State Dept., Washington, D. C.
DISCUSSIONS AND AGREEMENTS IN THE UNITED NATIONS ON IMPORTANT ISSUES ASSOCIATED WITH NUCLEAR POWER IN SPACE **c84**
Bruce C. Rashkow, Theodore A. Borek, Edward Keheley, Nathan J. Hoffman, and Bruce B. Gillies (Energy Technology Engineering Center, Canoga Park, Calif.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 177-179 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The United Nations (U.N.) has not agreed on a definition of a nuclear safe orbit below which a member state cannot have an operating nuclear power supply. The U.N. has not agreed on the definition of a reentry configuration for a nuclear power supply. Although the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space previously adopted a draft principle relating to the notification of the states concerned and the Secretary General by the launching state of the possible unintentional reentry of a nuclear power supply, that principle has been reopened for discussion. A draft principle for assistance by the launching country to nations affected by reentry has been reopened for discussion. The U.N. has not proscribed plutonium as a fuel for a space power reactor or isotopic heat source. The U.N. has not agreed upon a required orbital altitude or orbit decay time as a function of nuclear reactor power level. Author

N88-24412# Edgerton, Germeshausen and Grier, Inc., Rockledge, Fla. Advanced Technology.
CRITICAL NUCLEAR LAUNCH ISSUES: A PERSPECTIVE FROM THE STATE OF FLORIDA
Joseph A. Angelo, Jr. *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 181-187 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

A summary is given of the space nuclear power systems launched to date by the U.S. as well as some of the potential power applications in the future U.S. (civilian) space program. Safety concerns raised by these missions are addressed. Recommendations are given as a complement to the on-going aerospace nuclear safety program. Author

N88-24413# Science Applications International Corp., Clearwater, Fla.
SPACE REACTOR END OF LIFE ISSUES
Thomas E. Albert *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 191-193 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

End of life issues for space reactors are discussed. There are several considerations that should enter into decisions on space reactor end of life design features. Paramount of course is safety. Safety might be enhanced either for the normal mission, or perhaps even more importantly for an abnormal mission in which options for disposal at end of life might be critical. The extent to which provision for end of life disposal options would mitigate operational constraints for startup and operation of reactors in low Earth orbits may greatly extend the utility, or reduce the disadvantages of operating reactors in space. Author

N88-24414*# Energy Technology Engineering Center, Canoga Park, Calif.
SP-100 FLIGHT QUALIFICATION TESTING ASSESSMENT
Nanette M. Jeanmougin, Roger M. Moore, David L. Wait, and Michael G. Jacox (Air Force Weapons Lab., Kirtland AFB, N. Mex.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 195-198 Sponsored by NASA, Lewis Research Center, Aerospace Corp., Air Force Astronautics Lab., Air Force Space Div., Air Force Space Technology Center, Hanford Engineering Development Lab., Idaho National Engineering Lab., JPL, ORNL and Sandia National Labs (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 18I

The SP-100 is a compact space power system driven by a nuclear reactor that provides 100 kWe to the user at 200 VDC. The thermal energy generated by the nuclear reactor is converted into electrical energy by passive thermoelectric devices. Various options for tailoring the MIL-STD-1540B guidelines to the SP-100 nuclear power system are discussed. This study aids in selecting the appropriate qualification test program based on the cost, schedule, and test effectiveness of the various options. Author

N88-24415# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
LIQUID DROPLET RADIATOR DEVELOPMENT **c34**
J. B. Blackmon, D. G. Brown, R. E. Drubka, R. A. Gerrick, J. L. McNichols, and D. K. Edwards (California Univ., Irvine.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 199-204 (For primary document see N88-24374 17-73)
(Contract F04611-86-C-0111)
Avail: NTIS HC A99/MF A01

Systems analysis indicates that the liquid droplet radiator has potential mass advantages over conventional radiators. Researchers are pursuing this system to provide enabling technology for advanced high power space systems. To date, the concept remains feasible based on analysis of technical issues and preliminary experiments. Author

N88-24416# Sandia National Labs., Albuquerque, N. Mex. Advanced Nuclear Power Systems Safety Div.
THE EFFECT OF MAXIMUM ALLOWABLE PAYLOAD TEMPERATURE ON THE MASS OF A MULTIMEGAWATT SPACE BASED PLATFORM **c18**
Dean Dobranich *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 205-208 (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01

Two separate computer programs were used in conjunction to estimate the mass of a multimegawatt (MMW) platform as a function of the maximum allowable payload operating temperature. It was concluded that increasing the maximum allowable payload temperature results in a significant decrease in the platform mass for both the Brayton and Rankine cycle platforms. Author

N88-24417# Aerospace Corp., Albuquerque, N. Mex.
SPACE VEHICLE/NUCLEAR REACTOR THERMAL RADIATION INTEGRATION ISSUES **c18**
Richard D. Jimenez and Arthur W. Joslin *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 209-214 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The selection of spacecraft coatings for the SP-100 baseline subsystem must consider the degradation of their radiation surface properties. This degradation is the function of several parameters including the time in orbit and the orbit selected. The spectral characteristics of the SP-100 baseline thermal radiation sources must be considered when performing detailed heating and temperature calculations of the intrgrated space vehicle. The heating profile of the SP-100/space vehicle interface was shown to be a function of the interface radial position. Author

N88-24418# Sandia National Labs., Albuquerque, N. Mex.
MACRAD: A MASS ANALYSIS CODE FOR RADIATORS **c34**
Donald R. Gallup *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 217-220 (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01

MACRAD, a mass analysis code for radiators, is a parametric code for estimating the mass of heat pipe radiators. The parameters that can be varied during a run include heat pipe length, heat pipe diameter to length ratio, and wick radius. The parameters that remain constant during a run include condenser temperature, structural material, working fluid, wick type, orbit height, operation time, redundancy, and probability of survival. It was concluded that it is likely that heat radiators will be selected for use with the majority of space power systems, because they are based on a well established technology. Furthermore, for closed systems above the megawatt power level, the radiator will be the major contributor to system mass. When it is completed, MACRAD will be a valuable tool for estimating and optimizing the mass of heat pipe radiators. Author

N88-24419# Los Alamos National Lab., N. Mex. Advanced Engineering Technology.
HEAT PUMP-AUGMENTED SYSTEMS FOR SPACECRAFT THERMAL MANAGEMENT **c34**
Michael A. Merrigan and Robert S. Reid *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 221-226 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Reduction of the mass and area of spacecraft heat rejection systems is theoretically possible by increasing the rejection temperature through heat pumping. The feasibility of this approach is evaluated in terms of the parameters that influence the performance of such a system. These include the efficiencies of the heat engine used to power the system and the heat pump, the various temperatures, the mass penalties associated with power production and heat pumping, and the mass per unit area of the heat rejection radiator. A realistic range of values is considered for each of the parameters and the results are presented in terms of the mass augmentation ratio for the system. A conclusion from the study is that the usefulness of this approach will depend on its effect on overall system reliability. Author

N88-24420# Westinghouse Electric Corp., Madison, Pa. Advanced Energy Systems Div.
THE CURIE POINT RADIATOR **c34**
Mario D. Carelli, Robert A. Markley, Bill L. Pierce, and J. Ed Schmidt *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 227-230 (For primary document see N88-24374 17-73)
(Contract DE-AC03-85SF-15936)
Avail: NTIS HC A99/MF A01

The Curie Point Radiator (CPR) is an advanced radiator concept

that offers unique advantages in terms of possible improvements in space power system efficiencies, reduced radiator mass requirements and increased reliability for multimegawatt space power applications. The operating principle of the CPR is to transfer waste heat to small size ferromagnetic particles which are heated above their Curie point and released into space. As the particles lose heat by radiation, their temperature drops below the Curie point and thus they become ferromagnetic, again allowing recapture by a magnetic field; the particles are then collected and cycled again through the heat exchanger. Here, the design of two systems for different power applications is described. Author

N88-24421# Grumman Aerospace Corp., Bethpage, N.Y. Space Systems Div.

DYNAMIC ISOTOPE POWER SYSTEM CRITICAL COMPONENT VERIFICATION **c44**

Richard J. Pearson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 233-236 (For primary document see N88-24374 17-73)
(Contract F04701-85-C-0090)
Avail: NTIS HC A99/MF A01

The primary objective was to demonstrate the integrity and initial endurance of a 1987 technology foil gas-bearing system for the proposed He-Xe gas Dynamic Isotope Power System (DIPS) Closed Brayton Cycle (CBS) system for the Boost Surveillance and Tracking System (BSTS). The 1987 technology bearing design was characterized and compared to the 1978 technology design. Characterization consisted of a parasitic loss test, a static spring-rate test, and a dynamic spring rate test. Results demonstrated the increased stiffness in the new design due to the added backing spring which increases the bearing maximum effective load by over 35 percent, while improved coatings and added radius of curvature reduce parasite losses at and above the design loads. Author

N88-24422# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.

SNAP-DYN: PROVEN TECHNOLOGY FOR WEAR-TERM, HIGHER POWER IN SPACE **c44**

Richard A. Johnson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 239-242 Sponsored in part by Atomic Energy Commission, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The Department of Energy is currently preparing the Dynamic Isotope Power Subsystem (DIPS) for near-term space applications in the 1 to 10 kWe range. DIPS couples proven isotope heat source technology with the organic Rankine cycle power conversion technology or Brayton cycle technology. The natural path for DIPS technology growth to provide reliable, survivable power systems with capacity to 50 kWe and beyond is to substitute a Systems for Nuclear Auxiliary Power (SNAP) reactor for the isotope heat source. It is clear that in DIPS and SNAP-DYN, the U.S. has in hand the technology for reliable, survivable nuclear power systems for all envisioned near-term applications for the powers up to 50 kWe and beyond. Author

N88-24423# Argonne National Lab., Ill.

A NOVEL PLANT PROTECTION STRATEGY FOR TRANSIENT REACTORS

Samit K. Bhattacharyya, Walter C. Lipinski, and Nelson A. Hanan *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 243-246 (For primary document see N88-24374 17-73)
(Contract W-32-109-eng-38)
Avail: NTIS HC A99/MF A01

A novel plant protection system designed for use in the TREAT Upgrade (TU) reactor is described. The TU reactor is designed for controlled transient operation in the testing of reactor fuel behavior under simulated reactor accident conditions. Safe operation of the reactor is of paramount importance and the Plant Protection System (PPS) had to be designed to exacting requirements. Researchers believe that the strategy developed for the TU has potential application to the multimegawatt space reactors and represents the state of the art in terrestrial transient reactor protection systems. Author

N88-24424# California Univ., Los Angeles. Dept. of Mechanical and Nuclear Engineering.

EVALUATION OF UN FUEL PIN FAILURE MODES AND MOTION OF FUEL DURING SEVERE ACCIDENTS FOR REACTORS IN SPACE

Barclay S. Lew and David Okrent *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 247-251 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

It was found that phenomena such as surface tension and capillary (STC) and vapor forces are important mechanisms and should be explicitly considered for safety analysis in space. For the SP-100 design, the transient heatup to high temperatures can occur in a matter of hours, and the temperature gradients within the rod and the subassembly are small. Analysis is being completed to assess the failure modes of uranium nitride fuel and uranium species motion upon rod failure with emphasis upon fuel-fission product chemistry, including uranium nitride decomposition. These analysis should provide physical insights into the mechanisms for potential severe accidents in space. Author

N88-24425# Los Alamos National Lab., N. Mex.

REACTOR CORE COOLABILITY WITH REDUCED POWER LEVELS

Jay S. Elson and Charles R. Bell *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 253-255 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

When used in support of missions with low power requirements (less than about 30 kWe), SP-100-type reactors should be able to withstand severe loss-of-core events (instantaneous voiding of the lithium coolant from the entire core) without special design features. This inherent safety characteristic should be very beneficial in ensuring and communicating the safety of such missions. Author

N88-24426# Brookhaven National Lab., Upton, N. Y.

ANALYSIS OF A NUCLEAR ORBITAL TRANSFER VEHICLE REENTRY ACCIDENT **c18**

James R. Powell, Hans Ludewig, Otto W. Lazareth, and Frederick L. Horn *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 257-261 Sponsored by AFRPL, Edwards AFB, Calif. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The possible fission product release and subsequent consequences following a reentry accident of a Nuclear Orbital Transfer Vehicle (NOTV) based on a Particle Bed Reactor (PBR) are reviewed. Three possible missions are analyzed, each involving varying times at full reactor power. However, due to the details of the various missions (full power time versus coasting time) the fission product inventories do not scale linearly with burnup. Thus, the radiological release and estimated dose are not only a function of the burnup but also depend on the mission. Full power in all cases will be assumed to be 200 MWT. The mission, method of analysis, results, and recommendations are outlined. Author

N88-24427*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CREEP BEHAVIOR OF TUNGSTEN/NIOBIUM AND TUNGSTEN/NIOBIUM-1 PERCENT ZIRCONIUM COMPOSITES **c24**

D. W. Petrasek and R. H. Titran *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 267-272 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 11D

A study was conducted to determine the feasibility of using tungsten fiber reinforced niobium or niobium-1 percent zirconium

matrix composites to meet the anticipated increased temperature and creep resistance requirements imposed by advanced space power systems. The results obtained on the short time tensile properties indicated that W/Nb composites showed significant improvements in high temperature strength and offer significant mass reductions for high temperature space power systems. The prime material requirement for space power systems applications is long time creep resistance. A study was conducted to determine the effect of high temperature exposure on the properties of these composites, with emphasis upon their creep behavior at elevated temperatures. Author

N88-24428# Los Alamos National Lab., N. Mex.
THE APPLICATION OF HIGH-RATE BIAXIAL TESTING TO THE DESIGN OF CONTAINMENT VESSELS FOR RADIOISOTOPE HEAT SOURCES
Timothy G. George *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 273-277 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

High rate biaxial testing is an ideal tool for evaluating the design of containment vessels for radioisotope heat sources. The technique is relatively simple and can be used to investigate material response over a wide range of conditions. In addition, the combination of high-rate biaxial testing and heat source impact testing can provide information on the relative safety of a heat source design. Author

N88-24429# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
WELDABILITY OF GENERAL PURPOSE HEAT SOURCE IRIDIUM CAPSULES **c37**
William R. Kanne, Jr. *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 279-282 (For primary document see N88-24374 17-73)
(Contract DE-AC09-76SR-00001)
Avail: NTIS HC A99/MF A01

Weldability tests on General Purpose Heat Source (GPHS) iridium capsules showed that a new iridium fabrication process reduced susceptibility to underbead cracking. Seventeen capsules were welded (a total of 255 welds) in four categories and the number of cracks in each weld was measured. New process iridium was found to be less sensitive to weld underbead cracking than old process iridium. The 1500 C outgassing treatment has no effect on weldability. Long quenches have fewer cracks. There is considerable variability from shell to shell and from weld to weld in the crack counts. Middle welds have fewer cracks. Cracks visible at 30x are about half the total visible with dye penetrant. Author

N88-24430# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
ENERGY STORAGE EVALUATION FOR BURST POWER APPLICATIONS **c44**
John W. Meisner and Kenneth J. Metcalf *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 283-286 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The purpose was to provide a method of comparing space power systems that did not require the development of a detailed model and allowed the variation of input parameters to evaluate the effect on system mass. The technique developed uses a commercial spreadsheat program and personal computer to allow convenient user interaction during the model evaluation. Using this technique, a system can be modeled in a relatively short time. The spreadsheet technique allows a timely comparison and evaluation of a number of systems and alternatives prior to the selection of the system to be modeled in detail. Author

N88-24431# Oak Ridge National Lab., Tenn.
ENERGY STORAGE FOR NUCLEAR BURST POWER SYSTEMS **c44**
Mitchell Olszewski and David G. Morris *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 287-290 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

This analysis indicated that the inclusion of storage in sprint power systems can yield overall system mass savings. Thermal storage and regenerable electrical storage (using fuel cells, batteries and flywheels) can play a role in various power system concepts. The cost to close the power cycle can be modest. Given the large uncertainties associated with the acceptability of effluent clouds in sprint operations, it would appear reasonable to develop the closed cycle/storage systems in parallel. Author

N88-24432# Oak Ridge National Lab., Tenn.
VALUE ASSESSMENT OF ENERGY STORAGE CONCEPTS IN BURST POWER SYSTEMS **c44**
Moshe Siman-Tov, Mitchell Olszewski, and David E. Klett (North Carolina Agricultural and Technical State Univ., Greensboro.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 291-294 Previously announced as N88-17115 (For primary document see N88-24374 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A99/MF A01

Due to the pulsed nature of burst power demands, energy storage can be considered to effect reductions in overall system mass and reduce the area requirements for radiators. Incorporation of energy storage allows subsystems to be sized for orbital average duty. Without storage these systems must be sized to meet peak demands. Storage technologies include thermal (TES) and regenerable electrical energy (RES) storage. Technologies targeted for RES include flywheels, fuel cells and batteries. Author

N88-24433# Westinghouse Electric Corp., Sunnyvale, Calif.
ROTATING-HOOP, PULSED-ENERGY CONVERTER **c44**
Bobby D. McKee *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 295-298 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The rotating-hoop, pulsed energy converter (ROHPEC) is a system that uses an integrated generator/flywheel to store terajoules (1 times 10 to the 12th power J) of energy and deliver gigawatts of power. The generator and all associated power conversion and conditioning hardware will be modifications to existing designs. The flywheel will use composite technology that has been subscale tested. Author

N88-24434# TRW Defense and Space Systems Group, Redondo Beach, Calif.
CANDIDATE ADVANCED ENERGY STORAGE CONCEPTS FOR MULTIMEGAWATT BURST POWER SYSTEMS **c44**
John E. Boretz and Charles Sollo *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 299-302 (For primary document see N88-24374 17-73)
(Contract F27601-86-C-0214)
Avail: NTIS HC A99/MF A01

Three candidate advanced energy storage systems are reviewed and compared with the Thermionic Operating Reactor (THOR) concept. The three systems considered are the flywheel generator, the lithium-metal sulfide battery and the alkaline fuel cell. From a minimum mass viewpoint, only the regenerative fuel cell (RFC) can result in a lighter system than THOR. Because of its lower operating temperature, as compared to THOR, a considerable reduction in materials problems is to be expected when compared to the extremely high operating temperatures of the THOR system. Frozen heat pipes and their impact on response time as well as the complexity of the required retraction/extension mechanism of the THOR system would tend to place the RFC system in a much lower category of development risk. Finally, if spot shielding of sensitive electronic and power conditioning equipment becomes necessary for the reactor radiation environment of the THOR system, the weight advantage of the RFC system may become even greater. Author

N88-24435# Pacific Northwest Labs., Richland, Wash.
FABRIC RADIATORS **c34**
Zenen I. Antoniak and Michael G. Jacox (Air Force Weapons Lab., Kirtland AFB, N. Mex.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 303-306 Sponsored by AFWL, Kirtland AFB, N. Mex. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The design of large, high-temperature space radiators is still an evolving discipline. Researchers expanded the data base available to a designer by studying a novel class of radiators constructed of ceramic fabrics and/or composite materials. It appears that fabric radiators have features not available in more conventional radiator types, while offering the light weight and stowability of advanced radiators such as liquid droplet types. Experiments show that fabrics can be treated to become impermeable to the working fluid while retaining flexibility. This feature of fabrics, when allied to their low density, provides a material well-adapted to radiator construction. Author

N88-24436# Ebasco Services, Inc., New York.
A MULTIMEGAWATT SPACE POWER SOURCE RADIATOR DESIGN **c34**
Jacek Jedruch *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 307-311 (For primary document see N88-24374 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A99/MF A01

The design of a radiator for a multimegawatt power source proposed for deployment in the late 1990's to meet mission boost power requirements is discussed. The system is characterized by both high temperature and high pressure. Estimates are given of the size, mass and problems of orbiting such a radiator, based on the assumption that the next generation of heavy launch vehicle with 120 ton carrying capacity and 4000 cubic meter cargo volume will be available for putting hardware into orbit. Discussed in detail is the heat rejection part of a liquid metal magnetohydrodynamic energy conversion system. The underlying considerations for proper sizing of the He radiator and the philosophy guiding the conceptual design are discussed. Author

N88-24437# Air Force Inspection and Safety Center, Kirtland AFB, N. Mex. Weapons and Special Projects Branch.
THE LIQUID DROPLET RADIATOR IN SPACE: A PARAMETRIC APPROACH **c34**
Gerald L. Buckner and Ronald F. Tuttle (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 313-316 Sponsored by the Department of the Air Force, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The Liquid Droplet Radiator (LDR) consists of a column or sheet of liquid droplets moving through space from a droplet generator to a collector. The droplets carry the waste heat generated by a space power system and radiate this waste heat directly to space during their flight. The liquid droplets are collected at a lower temperature, reheated and pumped to the generator and reused to remove waste heat from the thermodynamic power cycle. A parametric analysis is given of a cylindrical LDR to estimate its performance and operating characteristics using a new pump specific mass term. Author

N88-24438# Texas A&M Univ., College Station. Advanced Nuclear Fuels Lab.
AN IRRADIATION PERFORMANCE DATA BASE FOR NITRIDE FUELS
Daniel E. Brozak, James K. Thomas, and Kenneth L. Peddicord *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 317-320 (For primary document see N88-24374 17-73)
(Contract DE-AC02-86NE-37960)
Avail: NTIS HC A99/MF A01

The work done for the development of an irradiation performance data base for nitride fuels is described. This data base was constructed from extensive literature search and review that emphasized uranium nitride (UN). Mixed nitrides, (U,Pu)N and carbonitrides, (U,Pu)C,N, were also included to increase the quality and breadth of available data. The nitride fuels data base provides a foundation for the construction and evaluation of fuel performance models and serves as an easily accessible and expandable source of fuel performance information. A fuel element temperature distribution code was developed to provide a complete and consistent set of temperatures for the data base. Author

N88-24439# Oregon State Univ., Corvallis. Dept. of Nuclear Engineering.
MICROGRAVITY THAW EXPERIMENT (MITEX) **c29**
Andrew C. Klein, Kean G. Stump, Gene Wallis, William J. Krotiuk, and Brent J. Webb (Battelle Pacific Northwest Labs., Richland, Wash.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 321-324 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The Microgravity Thaw Experiment (MITEX) is designed to give visual observations of solid-to-liquid phase change under constrained microgravity conditions similar to those that can be experienced in space. The experiment package is being developed for use on KC-135 parabolic flights in conjunction with Battelle prepared boiling and two-phase flow microgravity experiments. It is also adaptable to future Space Shuttle flights. Objectives to be demonstrated and observed include: the development and motion of voids and liquid areas as the ice melts in low gravity and comparison to ground tests; the relative magnitude of the conductive heat transport mechanism within the ice/liquid/void medium; comparisons of the lifetime of the central ice slug with ground tests; and the development of analytical models to treat both ground and flight tests. Author

N88-24440# Orion International Technologies, Albuquerque, N. Mex.
SPACE POWER REFERENCE SOURCE (SPRS): A USER'S GUIDE TO SDI SPACE POWER TECHNOLOGY PROGRAMS **c44**
L. B. Latham *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 325-328 (For primary document see N88-24374 17-73)
(Contract F29601-85-C-0060)
Avail: NTIS HC A99/MF A01

At present, there are numerous proposed systems designed to provide housekeeping, alert, and burst power to all space based Strategic Defense Initiative platform concepts. Previously the defense community has had no means to monitor all activities and parameters associated with space power development programs. The Space Power Reference Source (SPRS) is a comprehensive Information Management System (IMS) programmed in Revelation (TM), which allows the user to link bidirectionally for systems, subsystems, critical components, and government work package descriptions. SPRS also has a preprogrammed Figure of Merit algorithm that permits the ranking of systems based on user specified parameters. SPRS is an effective tool for tracking space power trends, comparing technologies for similar applications, and facilitating budget appropriations. However, further work is needed to optimize the Figure of Merit hierarchy, and to further evaluate the types of data needed to optimize SPRS for use as an administrative tool. Author

N88-24441# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
NUCLEAR PROPULSION: PAST, PRESENT AND FUTURE **c20**
V. E. Haloulakos and C. B. Boehmer *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 329-332 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The use of nuclear energy in rocket propulsion owes it genesis

to the success of work done on the KIWI and ROVER experimental reactor programs, and culminated with the NERVA rocket engine. The historic activities of the ROVER/NERVA programs are reviewed and the progress of the present activities in nuclear propulsion is presented. It is concluded that the technology and capabilities are available for direct nuclear propulsion to accomplish near-Earth orbit transfer, lunar and Mars missions. It only remains for the needs, economic feasibility and the socio-political questions to be ironed out before a full-scale effort is undertaken. Author

N88-24442# Idaho National Engineering Lab., Idaho Falls.
GAS CORE REACTORS FOR DIRECT NUCLEAR PROPULSION **c20**
Bruce G. Schnitzler *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 333-336 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Gas core nuclear reactors offer the potential for achieving very high specific impulse in a space propulsion engine. The investigation described characterized BeO reflected gas core reactors over a wide range of propulsion system performance levels. Parametric variables include cavity diameter, fuel volume fraction, reflector thickness, propellant temperature, and thermal power. Propulsion system performance characterization includes specific impulse, thrust, and mass estimates for the reflector, pressure shell and radiator. Neutron upscatter from low-z high temperature propellants strongly impacts calculated gas core critical loadings and propulsion engine performance. Author

N88-24443*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF HIGH POWER ELECTRIC PROPULSION TECHNOLOGY **c20**
David C. Byers and James R. Stone *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 337-340 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 21F

The growing emphasis on very challenging missions and the anticipated availability of high power levels in space have led to renewed interest in high power electric propulsion. The status of high power electric propulsion technology and its applicability to various missions are reviewed. The major thruster and system technology issues are identified which must be addressed in a focussed program in order to assure technology readiness for these missions. Author

N88-24444# Air Force Astronautics Lab., Edwards AFB, Calif.
NONCRYOGENIC PROPELLANTS FOR A NUCLEAR ORBIT TRANSFER VEHICLE **c28**
Ryan K. Haaland and Andrew Martin *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 341-344 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Recently imposed limitations regarding venting propellants in the STS payload bay may severely limit the capability to place heavier payloads in geosynchronous orbit by not allowing the use of current cryogenic propulsion systems. The two propulsion systems considered represent a wide range of nuclear reactor technology. The Small Nuclear Rocket Engine (SNRE) is derived from the Rover/NERVA program. The particle bed propulsion system represents a yet unproven reactor design offering a significant reduction in mass. Both systems are assumed to have the same operating conditions, approximately 250 Mwt, a chamber temperature of 2770 K, and a chamber pressure of 10.1 MPa. It is concluded that nuclear propulsion systems using various noncryogenic propellants offer a viable option for increasing the payload to GEO capability of the STS. The use of propellants that do not require venting, that is noncryogenic, coupled with a nuclear fission reactor should allow the development of high performance nuclear propulsion systems that meet STS payload safety requirements. A major concern is the effect of the noncryogenic propellants on the reactor concepts. Author

N88-24445# Air Force Astronautics Lab., Edwards AFB, Calif. Liquid Rocket Div.
SOLAR THERMAL PROPULSION FOR ORBIT TRANSFER VEHICLES **c20**
Charles R. Ford *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 345-348 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The low thrust of the solar rocket will increase trip time over state-of-the-art chemical propulsion. However, for payloads that are not time critical, the high specific impulse of the solar rocket will cut in half the propellant costs associated with chemical propulsion. Over a 10 year period, this cost savings would be substantial. For instance, a recent NASA study indicated that projected costs of delivering payloads from Earth to GEO in the next few years will be on the order of $20,000 to $50,000/lb of payload. A large percentage of this is associated with the LEO to GEO costs. Reducing these astronomical costs is a major concern of spacecraft designers. Solar thermal propulsion is one concept capable of performing orbit transfers very efficiently and economically. Author

N88-24446# Energy Technology Engineering Center, Canoga Park, Calif.
LIQUID METAL TESTING AT ETEC FOR THE SP-100 PROGRAM
Therese F. Triumph *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 353-354 Sponsored by DOE, San Francisco, Calif. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The technology goals of the SP-100 space program include the design, fabrication, testing and development of a space based power system. The purpose of the Liquid Metal Component Test Program at ETEC is to test the high temperature, lithium cooled, refractory metal SP-100 components at operating conditions. This requires ground testing in a high vacuum environment in order to avoid oxygen embrittlement of the Nb - 1 percent Zr refractory metal. What articles are to be tested and how, is presented. Author

N88-24447# Oak Ridge National Lab., Tenn.
REVIEW OF ALKALI METAL AND REFRACTORY ALLOY COMPATIBILITY FOR RANKINE CYCLE APPLICATIONS **c26**
James R. DiStefano *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 355-360 (For primary document see N88-24374 17-73)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A99/MF A01

Liquid metals make excellent high temperature coolants in Rankine cycle systems because of their unique physical and chemical properties. However, for use with refractory metal alloys in space power applications at high temperatures, compatibility is an important factor. The principal corrosion reactions in refractory metal alkali metal systems are due to dissolution, mass transfer, and impurity reactions. Corrosion testing to evaluate compatibility has included exposure of refractory metal alloys to static alkali metals in closed capsules, exposure to flowing alkali metals in natural circulation and forced circulation loops, exposure to condensing alkali metal vapor in refluxing capsules and boiling loops, and exposure to alkali metals in complex engineering systems. It is concluded that the most serious corrosion problems encountered in refractory metal-alkali metal systems have been due to impurity reactions associated with oxygen. Dissimilar metal mass transfer effects with stainless steels have also been noted, but below 1170 K results have not been catastrophic. In the absence of oxygen and other materials in the systems, corrosion rates have generally been extremely low. Author

N88-24448# Pacific Northwest Labs., Richland, Wash.
DEVELOPMENT OF MATERIALS FOR FABRIC RADIATORS **c34**
John T. Prater and James M. Bates *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 361-364 Sponsored in part by AFWL, Kirtland AFB, N. Mex. (For primary document see N88-24374 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A99/MF A01

Materials issues related to the incorporation of ceramic fabrics into spacebased radiator systems were reviewed. Preliminary results suggest that ceramic fibers can be combined with thin metal layers to provide an extremely durable, gas impermeable skin. The metal layer provides a barrier to prevent loss of the working fluid while the fabric provides the structural support. In this manner it should be possible to construct radiators that will be extremely lightweight and flexible. This is especially attractive from a launch and deployment perspective. Candidate material combinations were identified that could be used in conjunction with different working fluids (HeXe, NaK, Li) at temperatures up to at least 900 C. Author

N88-24449# Rasor Associates, Inc., Sunnyvale, Calif.
RESEARCH AND DEVELOPMENT OF ELECTRICAL INSULATORS FOR THERMIONIC APPLICATIONS **c27**
Jesse C. Dobson, Frank W. Clinard, Jr., and Larry D. Woolf (GA Technologies, Inc., San Diego, Calif.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 365-368 (For primary document see N88-24374 17-73)
(Contracts DE-AC03-87SF-17169; DE-AC03-86SF-16298; W-7405-eng-36)
Avail: NTIS HC A99/MF A01

Current designs for Thermionic Fuel Elements (TFE) require the use of a sheath insulator to electrically isolate the collector from the liquid metal coolant. In the TFE Verification Program, the work is divided into 3 major tasks: manufacturing development, testing, and modeling. The tasks were executed interactively to produce a sheath insulator that meets the desired performance levels: a maximum temperature drop of 21 K and a minimum electrical resistance of 270 ohms with an ionic conductivity of less than 4 x 10 to the -11th/(ohm-cm). The manufacturing efforts focused on the areas of manufacture of flawless sheath insulator packages with consistent, well characterized microstructure. Testing had the dual purpose of evaluating the manufacturing program and of providing guidance to the modeling efforts. Modeling initially concentrated on developing a method of predicting the onset of dielectric breakdown due to electrolysis and chemical diffusion. The program has shown that sheath insulators can be manufactured that are capable of meeting initial performance specifications, and whose lifetime can be modeled in the absence of a radiation field. Author

N88-24450# Argonne National Lab., Ill.
MONOLITHIC FUEL CELL BASED POWER SOURCE FOR BURST POWER GENERATION **c44**
D. C. Fee, P. E. Blackburn, D. E. Busch, D. W. Dees, J. Dusek, T. E. Easler, W. A. Ellingson, B. K. Flandermeyer, R. J. Fousek, and J. J. Heiberger et al. *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 369-373 Sponsored by Strategic Defense Initiative Organization, Washington, D.C., DOE, Washington, D.C. and Defense Advanced Research Projects Agency, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

A unique fuel cell coupled with a low power nuclear reactor presents an attractive approach for SDI burst power requirements. The monolithic fuel cell looks attractive for space applications and represents a quantum jump in fuel cell technology. Such a breakthrough in design is the enabling technology for lightweight, low volume power sources for space based pulse power systems. The monolith is unique among fuel cells in being an all solid state device. The capability for miniaturization, inherent in solid state devices, gives the low volume required for space missions. In addition, the solid oxide fuel cell technology employed in the monolith has high temperature reject heat and can be operated in either closed or open cycles. Both these features are attractive for integration into a burst power system. Author

N88-24451# United Technologies Corp., South Windsor, Conn. Power Systems Div.
HIGH POWER DENSITY ALKALINE FUEL CELL TECHNOLOGY FOR MMW SPACE BURST POWER **c44**
J. Lawrence Preston, Jr., John C. Trocciola, and Ronald J. Wertheim (International Fuel Cells Corp., South Windsor, Conn.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 375-378 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The use of advanced alkaline regenerative fuel cell energy storage systems to provide 10's to 100's of MWe of sprint (burst) power for 100's of seconds per orbit of SDI weapons platform was studied. Recharge power is supplied by a multimegawatt space based nuclear power system. Regenerative fuel cell energy storage systems offer the potential for significant platform mass reduction by reducing the size and mass of the nuclear power source required. This is because the reactor can be sized for the smaller average power level for the energy storage system, rather than the sprint power level. The regenerative fuel cell is a particularly attractive energy storage device because the fuel cell is essentially a static power conversion device, which results in excellent platform stability for weapon pointing and tracking. Based upon the detailed point design and conceptual layout, the alkaline regenerative fuel cell energy storage system is an attractive choice for integration with a nuclear thermionic system for providing multimegawatt burst power and multi orbit capability. Author

N88-24452# Los Alamos National Lab., N. Mex.
POLYMER FUEL CELL AS AN ENERGY STORAGE COMPONENT FOR SPACE POWER APPLICATIONS **c44**
Carmelo A. Spirio and Nicholas E. Vanderborgh *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 381-383 Sponsored by DOE, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Fuel cells have already been proposed as energy storage candidates for space applications in the multimegawatt regime in a number of studies and the projected performance seems to satisfy the severe requirement of high power density. These chemical energy based systems are particularly important when the mission duration is in the 1000 second domain. Recent measured performance of experimental polymer membranes operating on pure gases has brought this technology into the candidate arena because of its potential near term availability as space traceable hardware. An energy storage system is described which furnishes the mission power for a number of applications, including its candidacy for the SDI. Contemporary fuel cell systems are a factor of nearly 50 below the power density needed for the platform requirements. Author

N88-24453# Argonne National Lab., Ill.
BENCHMARK PHYSICS EXPERIMENTS FOR SP-100
David N. Olsen, Stuart G. Carpenter, Gary L. Grasseschi, and Dale M. Smith *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 387-391 (For primary document see N88-24374 17-73)
(Contract W-31-109-eng-38)
Avail: NTIS HC A99/MF A01

A space nuclear power system (SNPS) benchmark reactor physics program was performed at Argonne's Zero Power Physics Reactor (ZPPR). Two uranium fuelled, BeO reflected reactors were assembled to test 300 kWe conceptual designs considered for the SP-100. The major difference between configurations was the reactivity control concept. Program goals were to aid designers in evaluating SP-100 designs and provide guidance in defining a

series of engineering mockup criticals to be performed in support of the ground engineering test. ZPPR-16 was a short program aimed at providing basic physics data for cores representing early SP-100 designs. All measurement results from the experimental program are available. Initial analysis, using standard deterministic methods, shows significant errors when compared against the measurements. Calculational difficulties are enhanced by the need to model a natural B4C/graphite room-return shield used in the ZPPR experiments. Author

N88-24454# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
TRADE STUDY FOR kWe CLASS SPACE REACTORS
Donald S. Bost *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 393-396 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Recent interest by NASA and other government agencies in space reactor power systems with power levels in the 1 to 100 kWe range has prompted a review of earlier space reactor programs, as well as the ongoing SP-100 program, to identify a system that will best fulfill their needs. The candidate reactor types that were reviewed are listed. They are categorized according to the method of heat removal. The five types are: conduction cooled, heat pipe cooled, liquid metal cooled, in-core thermionic and gas cooled. The UZrH moderated reactor coupled with an organic Rankine cycle power conversion system provides an attractive system for multikilowatt, long lived missions. The reactor requires a minimum development because a similar reactor has already flown and the ORC is being developed for use in the Dynamic Isotope Power System (DIPS) and on the Space Station. Author

N88-24455# Pacific Northwest Labs., Richland, Wash.
A HIGH POWER DENSITY RADIAL-IN-FLOW REACTOR SPLIT CORE DESIGN FOR SPACE POWER SYSTEMS
Edmund P. Coomes *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 397-401 (For primary document see N88-24374 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A99/MF A01

Application of the Rankine cycle to space power systems is difficult because of the problems and complexities associated with two phase flow systems in microgravity. A direct cycle system which could provide super heated vapor to the turbine inlet would greatly enhance the development of Rankine cycle power systems for space applications. The split core radial-in-flow reactor design provides a safe reliable core design for space power systems. It makes direct Rankine cycle power systems a very competitive design, eliminating the boiler and additional pumps of an indirect cycle along with the liquid vapor separator. A continuous power Rankine cycle system using this core design would produce the least weight system of any having the same power output.
Author

N88-24456# Argonne National Lab., Ill.
TRANSIENT ANALYSES OF MULTIMEGAWATT SPACE REACTORS
Nelson A. Hanan and Samit K. Bhattacharyya *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 403-407 (For primary document see N88-24374 17-73)
(Contract W-32-109-eng-38)
Avail: NTIS HC A99/MF A01

Several systems have been proposed for the generation of multimegawatt power for space applications. In some concepts, a nuclear reactor is proposed to meet all the power requirements; for other concepts, a nuclear reactor is proposed to deliver the housekeeping and alert power, and other systems are proposed to meet the burst power requirements. A common requirement for all the nuclear concepts is a fast response for change of power level from the housekeeping mode to either the alert or burst mode of operation. First, the requirements imposed on the control system of two reactor concepts, a Liquid Metal Reactor and a gas cooled reactor, having as its main objective the determination of the maximum input reactivity rates and control drum speed to rotation necessary to meet the power requirements, are presented. Next, preliminary analysis to validate the point kinetics against detailed space-time kinetics calculations is discussed. Author

N88-24457# Argonne National Lab., Ill.
MMW SHIELDING DESIGN AND ANALYSIS
Arne P. Olson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 409-414 (For primary document see N88-24374 17-73)
(Contract W-31-109-eng-38)
Avail: NTIS HC A99/MF A01

Reactor shielding for multimegawatt (MMW) space power must satisfy a mass constraint as well as performance specifications for neutron fluence and gamma dose. A minimum mass shield is helpful in attaining the launch mass goal for the entire vehicle, because the shield comprises about 1 to 2 percent of the total vehicle mass. Also, the shield internal heating must produce tolerable temperatures. Finally, the shield materials must remain physically and chemically stable for the lifetime of the vehicle. Shield performance for neutrons and gammas is studied. The derived heating rates are essential inputs for auxiliary calculations to predict temperature profiles, thermal expansion, thermal stresses, and structural strength. Topics addressed include cross section preparation for multigroup 2D S sub n transport analyses, and the results of parametric design studies on shadow shield performance and mass versus key shield design variables such as cone angle, number, placement, and thickness of tungsten layers, and shield top radius. Finally, adjoint methods are applied to the shield in order to spatially map its relative contribution to dose reduction, and to provide insight into further design optimization. Author

N88-24458# Westinghouse Electric Corp., Madison, Pa. Advanced Energy Systems Div.
THE NERVA DERIVATIVE REACTOR AND A SYSTEMATIC APPROACH TO MULTIPLE SPACE POWER REQUIREMENTS
J. E. Schmidt, J. F. Wett, and J. W. H. Chi *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 415-416 Sponsored in part by Department of the Air Force, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Increasing needs for electric power for various space missions have been identified. They include multikilowatts of electric power for station keeping, megawatts of power for orbital transfer and for a lunar base, and multimegawatts of power for SDI weapon systems. The magnitudes and durations of the power requirements are such that only nuclear-electric power can provide the most economical and practical power sources. Among the different types of nuclear reactors for the various applications, the most practical concept, capable of fulfilling the multiple space power requirements using a single reactor technology is the NERVA Derivative Reactor (NDR) based upon the proven reactor technology developed under the Nuclear Engine Rocket Vehicle Applications/Rover programs. A description is provided of the NDR, the different types of NDR-based space power systems, and the design issues and engineering requirements are discussed. Author

N88-24459# General Electric Co., Philadelphia, Pa. Astro Space Div.
CERAMIC ELECTRICAL INSULATOR DEVELOPMENT FOR THERMOELECTRIC SACE POWER SYSTEM Abstract Only **c27**
Solomon Musikant *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 417 (For primary document see N88-24374 17-73)
(Contract DE-AC03-86SF-16006)
Avail: NTIS HC A99/MF A01

The current development of a high temperature ceramic insulator for use in a 100 kW thermoelectric power generator for space application is summarized. Both oxide and nitride ceramics

are being investigated. Depending on the thermal conductivity of the material selected, the insulator thickness may be from 0.010 to 0.040 in. thick and approx. 1 x 1 in. in areal size. The insulator must have high thermal conductivity, low electrical conductivity and operate at 1025 C for 7 yrs under an impressed voltage up to 100 VDC in a space environment. Low thermal impedance joints are being developed to join the ceramic insulator to the adjacent elements of the thermoelectric pile. Author

N88-24460# General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
APPARATUS FOR THE MEASUREMENT OF RESISTIVITY OF GLASSES AND CERAMICS **c27**
Jack Hanson and Kenneth Bleiler *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 419-421 (For primary document see N88-24374 17-73)
(Contract DE-AC03-86SF-16006)
Avail: NTIS HC A99/MF A01

Apparatus were constructed to measure the electrical resistivity of candidate ceramic and glass insulators for use on the SP-100 project. The initial or prototype instrument was used to perform measurements from room temperature to 1325 K in a vacuum of approx. 1,000,000 torr. Subsequently, several other measurement facilities were made for long term tests at temperatures up to 1575 K. The data from this facility has been described in previous papers. To date samples of BN, AlN, Si3N4, Al2O3 and BeO have been measured as well as several high temperature glasses. Author

N88-24461# Sandia National Labs., Albuquerque, N. Mex.
SILICON-ON-INSULATOR ELECTRONICS FOR A SPACE NUCLEAR POWER SYSTEM **c27**
Daniel M. Fleetwood and Sylvia S. Tsao *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 423-426 (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01

Providing instrumentation and control for space based nuclear power systems requires advanced very large scale integrated circuits (VLSI ICs). These devices must be able to withstand extreme radiation environments and, to reduce system mass and simplify thermal management, may also be required to withstand temperatures as high as 300 C. These requirements represent a major challenge to present and future generations of VLSI ICs. Results that suggest that these requirements may be satisfied by devices made in a silicon-on-insulator (SOI) technology is illustrated and summarized. Author

N88-24462# Sandia National Labs., Albuquerque, N. Mex.
THE RESPONSE OF SELECTED SEMICONDUCTOR TECHNOLOGIES TO THE COMBINED ENVIRONMENTAL EFFECTS OF HIGH TEMPERATURE AND TOTAL DOSE GAMMA RADIATION **c76**
D. B. King, W. T. Wheelis, and S. M. Luker *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 427-430 (For primary document see N88-24374 17-73)
(Contract DE-AC04-75DP-00789)
Avail: NTIS HC A99/MF A01

Some of the circuitry used to control a nuclear reactor is exposed to potentially high radiation levels and temperatures. A series of tests using a power MOSFET, a dielectric isolated operational amplifier, and SOI (silicon on insulation) MOSFETs was designed to simulate as closely as possible the environment that these devices would be exposed to in space nuclear reactors. The tests exposed the devices to combined environments exceeding typical testing limits currently being used to qualify electronic components. Some results indicate: (1) device parametric failure occur at 423 to 473 K; functional failure in excess of 573 K; (2) dielectrically isolated devices are not as temperature sensitive as standard silicon devices; (3) discrete devices are rugged in terms of temperature and radiation tolerance when operation is in a digital mode; (4) the MOSFETs parametrically failed at tens of krads of gamma exposure; however, they continue to operate to 100 Mrads with very little gate threshold change after 30 Mrad; and (5) positive synergism occurs with increasing temperature and radiation. Author

N88-24463*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NEUTRON EFFECTS ON THE ELECTRICAL AND SWITCHING CHARACTERISTICS OF NPN BIPOLAR POWER TRANSISTORS **c33**
Albert J. Frasca (Wittenberg Univ., Springfield, Ohio.) and Gene E. Schwarze *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 431-435 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 09C

The use of nuclear reactors to generate electrical power for future space missions will require the electrical components used in the power conditioning, control, and transmission subsystem to operate in the associated radiation environments. An initial assessment of neutron irradiation on the electrical and switching characteristics of commercial high power NPN bipolar transistors was investigated. The results clearly show the detrimental effects caused by neutron irradiation on the electrical and switching characteristics of the NPN bipolar power transistor. Author

N88-24464*# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering and Applied Mechanics.
NUCLEATE POOL BOILING: HIGH GRAVITY TO REDUCED GRAVITY; LIQUID METALS TO CRYOGENS **c29**
Herman Merte, Jr. *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 437-442 (For primary document see N88-24374 17-73)
(Contract NAS8-20228; Grants NAG3-633; NAG3-589)
Avail: NTIS HC A99/MF A01 CSCL 22A

Requirements for the proper functioning of equipment and personnel in reduced gravity associated with space platforms and future space station modules introduce unique problems in temperature control; power generation; energy dissipation; the storage, transfer, control and conditioning of fluids; and liquid-vapor separation. The phase change of boiling is significant in all of these. Although both pool and flow boiling would be involved, research results to date include only pool boiling because buoyancy effects are maximized for this case. The effective application of forced convection boiling heat transfer in the microgravity of space will require a well grounded and cogent understanding of the mechanisms involved. Experimental results are presented for pool boiling from a single geometrical configuration, a flat surface, covering a wide range of body forces from a/g = 20 to 1 to a/g = 0 to -1 for a cryogenic liquid, and from a/g = 20 to 1 for water and a liquid metal. Similarities in behavior are noted for these three fluids at the higher gravity levels, and may reasonably be expected to continue at reduced gravity levels. Author

N88-24465*# Pacific Northwest Labs., Richland, Wash.
REDUCED-GRAVITY TWO-PHASE FLOW EXPERIMENTS IN THE NASA KC-135 **c29**
Judith M. Cuta, Thomas E. Michener, Frederick R. Best, and Leo J. Kachnik (Texas A&M Univ., College Station.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 443-446 Sponsored by NASA, Washington, D.C., DOE, Washington, D.C. and Wright-Patterson AFB, Ohio (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 22A

An adequate understanding is sought of flow and heat transfer behavior in reduced and zero gravity conditions. Microgravity thermal-hydraulic analysis capabilities were developed for application to space nuclear power systems. A series of reduced gravity two phase flow experiments using the NASA KC-135 were performed. The objective was to supply basic thermal hydraulic information that could be used in development of analytical tools for design of space power systems. The experiments are described.

Two main conclusions were drawn. First, the tests demonstrate that the KC-135 is a suitable test environment for obtaining two phase flow and heat transfer data in reduced gravity conditions. Second, the behavior of two phase flow in low gravity is sufficiently different from that obtained in 1 g to warrant intensive investigation of the phenomenon if adequate analytical tools are to be developed for microgravity conditions. Author

N88-24466*# Pacific Northwest Labs., Richland, Wash.
ANALYSIS AND INTERPRETATION OF LOW GRAVITY BOILING EXPERIMENTS IN THE KC-135 **c29**
Judith M. Cuta, William J. Krotiuk, and Jeffery W. Samuels (Oregon State Univ., Corvallis.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 447-450 Sponsored by NASA, Washington, D.C., DOE, Washington, D.C. and Northwest Coll. and University Association for Science (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 22A

Reduced gravity two phase flow boiling and condensing experiments were conducted in the NASA KC-135. In an attempt to gain a better understanding of two phase flow behavior in reduced gravity, the individual test runs were critically examined to determine their suitability to be taken as representative of two phase flow in microgravity. Selected runs were simulated using the two fluid thermal-hydraulic COBRA/TRAC computer code. The comparisons of these sophisticated codes with the observed flow behavior illustrate the generic shortcomings of current two phase modeling capabilities in application to reduced gravity conditions. Author

N88-24467*# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
MICROGRAVITY TWO-PHASE FLUID FLOW PATTERN MODELING **c29**
Doojeong Lee and Frederick R. Best *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 451-455 Sponsored by NASA, Lyndon B. Johnson Space Center, Houston, Tex. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 22A

When gas and liquid mixtures flow in a pipe, the distribution of the two phases may take many forms. A flow pattern, or flow regime, is the characteristic spatial distribution of the phases of flow in a pipe. Because heat transfer and pressure drop are dependent on the characteristic distribution of phases, it is necessary to describe flow patterns in an appropriate manner so that a hydrodynamic or heat transfer theory applicable to that can be chosen. A theoretical two phase flow regime transition map under a microgravity environment was developed on physical concepts. These transitions use four basic flow patterns: dispersed flow, slug flow, stratified flow, and annular flow. The forces considered are body force, surface tension force, inertial force, friction, and the force from eddy turbulent fluctuation. Three dimensionless parameters were developed. Because these transition boundaries were developed based on physical concepts, they should be applicable to flow regimes occurring in various design conditions. Because the flow pattern data from KC-135 experiments are insufficient to verify these theoretical transition lines completely, an adiabatic experiment for flow regime analysis is recommended. Author

N88-24468# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
EXPERIMENTAL INVESTIGATION OF A MICROGRAVITY SEPARATOR FOR TWO PHASE MIXTURES CONTAINING SMALL VOLUMES OF GAS/VAPOR **c39**
Vladimir M. Valentekovich and Vijay K. Dhir *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 457-460 Sponsored in part by Southern California Edison Co., Los Angeles (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

A space based nuclear power plant employing a Rankine cycle requires that liquid be separated from vapor in the boiler and gas/vapor be separated from the liquid in the condenser. Separation requirements may also exist in other power concepts such as the separation of chemical species. Thus an optimum separator, in terms of pressure drop, separation efficiency, and predictable operation for a wide range of flow conditions, is a must for the successful application of some of the power concepts that have been proposed for use in space. The design and performance characteristics are described of a tangential flow phase separator for use in space nuclear power. Author

N88-24469*# Sundstrand Corp., Rockford, Ill.
EXPERIMENTAL DEMONSTRATIONS OF ORGANIC RANKINE CYCLE WASTE HEAT REJECTION SYSTEMS **c44**
Timothy J. Bland and P. Douglas Lacey *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 461-463 Sponsored by NASA, Lyndon B. Johnson Space Center, Houston, Tex., NASA, Lewis Research Center, Cleveland, Ohio and Grumman Aerospace, Bethpage, N.Y. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 10B

Two phase fluid management is an important factor in the successful design of organic Rankine cycle (ORC) power conversion systems for space applications. The evolution of the heat rejection system approach from a jet condenser, through a rotary jet condenser, to a rotary fluid management device (RFMD) with a surface condenser has been described in a previous paper. Some of the test programs that were used to prove the validity of the selected approach are described. Author

N88-24470# Kentucky Univ., Lexington. Dept. of Mechanical Engineering.
LOW GRAVITY THERMAL MANAGEMENT USING DIELECTROPHORETIC FORCES **c29**
Jay H. Ambrose, Louis C. Chow, Donald E. Tilton, and Tom Mahefkey (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 465-468 Sponsored in part by AFOSR, Bolling AFB, Washington, D.C. and AFAPL, Wright-Patterson AFB, Ohio (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The subjects of two phase flow and heat transfer in a microgravity environment are important in the design of advanced thermal control systems for spacecraft. Among such systems is a distributed, two phase thermal bus which would collect waste heat from various components by evaporation of a working fluid and return the vapor to a central radiator for condensation and redistribution. To allow energy transport over greater distances, active pumping is favored over capillary pumping. This creates a need for phase separation and control of the working fluid. The use of high strength, nonuniform electric fields to control the collection and removal of the liquid phase of a dielectric working fluid is addressed. Two configurations are examined, one for a dispersed two phase regime and one in which a laminar liquid film collects on a wall. Author

N88-24471# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
A NUCLEAR POWERED SPACE BASED MULTIMEGAWATT MHD DISC POWER SYSTEM **c75**
Robert R. Holman, Joseph R. Lance, Lawrence E. VanBibber, and Jean F. Louis (Massachusetts Inst. of Tech., Cambridge.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 469-472 (For primary document see N88-24374 17-73)
(Contract DE-AC22-87PC-79665)
Avail: NTIS HC A99/MF A01

A very compact space based magnetohydrodynamic (MHD) power system capable of meeting space platform burst power needs is examined. An open cycle MHD disc generator concept has been incorporated in a nuclear power system arrangement. Thermal energy for the system is provided by a NERVA derivative

nuclear reactor and the MHD disc generator is used for thermal to electric energy conversion. Study results show to date that the NERVA derivative reactor coupled with the MHD disc generator provides a low total system launch mass and a very high energy extraction of greater than 20 MJ/kg in power operation. This energy extraction is much higher than the less than 2.5 MJ/kg values of linear MHD generator systems studied previously. Author

N88-24472# Florida Univ., Gainesville.
BURST POWER GAS CORE REACTOR WITH MHD POWER GENERATION c75
Edward T. Dugan, William E. Lear, Jr., and Gerard E. Welch *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 473-477 Sponsored in part by Frederick A. Hauck Fund, Florida Univ., Gainesville, AFWAL, Wright-Patterson AFB, Ohio and NSF Supercomputer Center, San Diego, Calif. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Research is being conducted on gas core reactors for space nuclear power to establish the feasibility and engineering validation of a reactor and energy conversion system that can significantly improve specific power, dynamic performance and system efficiency as compared to current state-of-the-art reactor systems. Rapid achievement of burst mode operation at core power densities of 1 kW/cu cm and system specific powers of at least a few kWe/kg are research objectives; coupled with Magnetohydrodynamic (MHD) conversion, system efficiencies of 25 percent and heat rejection temperatures of 1200 K or higher are anticipated. The design of a gas core reactor MHD generator configuration to directly produce pulsed electrical power, thereby alleviating external power conditioning requirements, is also a research objective. Author

N88-24473# Space Power, Inc., San Jose, Calif.
GIGAWATT, CLOSED CYCLE, VAPOR CORE-MHD SPACE POWER SYSTEM CONCEPTUAL DESIGN STUDY c75
Joseph R. Wetch, Hyop S. Rhee, J. Kent Koester, Julius Goodman, and Issac Maya (California State Univ., Long Beach.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 479-483 (For primary document see N88-24374 17-73)
(Contract DNA001-85-C-0320)
Avail: NTIS HC A99/MF A01

A preliminary design was developed for a closed cycle vapor core reactor with the potential for producing gigawatts of electrical power for thousands of seconds. The major issues of the design are achieving adequate cavity wall cooling with the vaporizing calcium working fluid, achieving adequate electrical conductivity in the MHD duct, and management of gigawatt levels of thermal power. Preliminary solutions were developed for these, making the concept a potential contender for providing Strategic Defense Initiative burst power levels. Author

N88-24474# Wisconsin Univ., Madison. Fusion Technology Inst.
CRITICAL ISSUES FOR SOAR: THE SPACE ORBITING ADVANCED FUSION POWER REACTOR c75
J. F. Santarius, G. L. Kulcinski, L. A. El-Guebaly, G. A. Emmert, Z. Musicki, M. E. Sawan, I. N. Sviatoslavsky, W. F. Vogelsang, P. L. Walstrom, and L. J. Wittenberg *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 485-488 Sponsored by Department of the Air Force, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The conceptual design of the Space Orbiting Advanced Fusion Power Reactor (SOAR) achieved a specific mass of approximately 0.5 kg/kWe at an electric power level of 1000 MWe. That design is summarized and scaling the power output in order to assess alternative applications of the concept is examined. Critical issues that arose in the first phase of this study (plasma physics issues, restart capability, fueling, high voltage direct converter design, and the operational impact of low radioactivity) will also be discussed. Author

N88-24475# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
COMPARISON OF 20-kWe SPACE NUCLEAR POWER SYSTEMS: IMPACT OF REACTOR TEMPERATURE AND TECHNOLOGY UPON SYSTEM DESIGN AND PERFORMANCES
F. Carre, E. Proust, S. Chaudourne (Commissariat a l'Energie Atomique, Grenoble, France), P. Keirle, Z. Tilliette, J. Trouve, and B. Vrillon *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 489-494 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The design studies dedicated to three concepts of 20 kWe turboelectric power systems, purposely selected to cover a wide range of technologies applicable to low power systems are presented. The system performances will be analyzed as a function of reactor temperature and of the relevant technology. Author

N88-24476# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
POTASSIUM RANKINE POWER SYSTEM FOR SPACE POWER c44
E. B. Baumeister and William R. Determan *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 495-498 (For primary document see N88-24374 17-73)
(Contract ORNL-IIX-02207V)
Avail: NTIS HC A99/MF A01

A review of the proposed concepts for multimegawatt (MMW) power levels in Strategic Defense Initiative applications was completed. A trade study format was used to evaluate currently proposed MMW ALERT mode concepts to determine which of these concepts could best meet the program requirements for steady-state and burst MMW power levels in Category 2. The MMW program's evaluation criteria were applied to each concept to determine its relative ranking within each criteria category. These criteria included the system characteristics related to its safety, reliability, mass, volume/area, technical risk, costs, environmental exposure, and growth potential. Technical feasibility issues associated with the successful development of each concept was also identified. An overall system concept ranking was developed for the four concepts that appeared to best meet the Category 2 MMW program requirements. The in-core thermionic and potassium Rankine power system concepts received the highest relative rankings from this study. The AMTEC and CBC technologies were ranked as distant second and third candidates, respectively. Rocketdyne has selected the potassium Rankine power system concept for additional study based upon its superior growth potential over the in-core thermionic MMW concept. Author

N88-24477# Idaho National Engineering Lab., Idaho Falls.
LOW CROSS-SECTION Mo-Nb THERMOCOUPLES FOR NUCLEAR APPLICATION: THE STATE-OF-THE-ART c35
S. Curtis Wilkins *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 499-502 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Current thermocouple technology is inadequate to provide instruments that are capable of making accurate, reliable long-term temperature measurements under conditions of high neutron irradiation, such as may exist in space nuclear power systems. Standard high-temperature W-Re alloys suffer significant transmutation and thermoelectric decalibration, and other standard thermocouples lack the necessary temperature range and radiation immunity for such applications. Thermocouples composed of pure Mo and Nb are virtually insensitive to transmutation effects, but are limited by drift and contamination and lack the desired temperature sensitivity above 1800 K. Highly promising alloys of Mo and Nb, originally developed in France, offer significant improvements over the pure-metal combination, but did not reach the application stage before development was discontinued. Work

at the INEL has attempted to produce small-diameter wires of these alloys for use in standard thermocouple configurations. While that goal is not yet attained, there was progress toward it; once achieved, full metrological characterization of the Mo-5 percent Nb/Nb-10 percent Mo thermocouple will be undertaken and its application in nuclear systems explored. Author

N88-24478# Westinghouse Hanford Co., Richland, Wash.
DEVELOPMENT OF REFRACTORY THERMOCOUPLES FOR SPACE NUCLEAR POWER TESTS **c35**
R. Craig Knight and Larry H. Schoenlein (Pacific Northwest Labs., Richland, Wash.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 503-506 (For primary document see N88-24374 17-73)
(Contract DE-AC06-87RL-10930)
Avail: NTIS HC A99/MF A01

A total of 16 thermocouples are required to monitor and control temperature in eight special refractory Materials Open Test Assembly (MOTA) canisters. A literature search was conducted to establish a matrix of candidate materials for the thermocouples. A series of tests were assembled and conducted in vacuum furnaces at temperatures of up to 2200 K. Test evaluations were based on electrical performance, metallographic examinations, and qualitative scanning electron microscope analysis. The thermocouples were fabricated and installed in the MOTA canisters. Irradiation testing is scheduled to begin in November 1987. B.G.

N88-24479# Superior Electric Co., Bristol, Conn.
ANGULAR POSITION MEASUREMENTS AT HIGH TEMPERATURES AND HIGH RADIATION ENVIRONMENTS **c35**
Robert S. Lundin *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 509-511 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

A Sin/Cos resolver concept, together with associated circuitry incorporating the signal error correction techniques is described. The reduction to practice is compared with predicted results for both single-cycle and multi-cycle resolvers, and the changes in construction format necessary for extending the temperature range above 500 degrees Kelvin is discussed. The construction and the principles of operation of the extended temperature version circumvent the difficulties inherent in the conventional Sin/Cos resolver at such temperatures. The construction format of the extended temperature version is different from any commercially available resolver. This difference is due to the inability to insulate the windings from the iron core, together with the special needs attendant to maintaining dimensional integrity at such temperatures. Equally important to the successful operation at temperatures above 500 degrees Kelvin in the concept developed for the correction of signal errors. These features, all incorporated in the design of the extended temperature version of the resolver, enables it to be considered for use in the hostile environment of space power systems such as the SP-100 or the Multimegawatt Space Power System. Author

N88-24480# Oak Ridge National Lab., Tenn.
JOHNSON NOISE THERMOMETER FOR HIGH-RADIATION AND HIGH-TEMPERATURE ENVIRONMENTS **c35**
Lester C. Oakes and Robert L. Shepard *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 515-519 Previously announced as N88-17911 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The purpose of development work on the Johnson noise power thermometer (JNPT) was to apply the work of Nyquist, who showed that the mean-squared noise voltage spectrum appearing across an unloaded resistor of the value R is given by anti e sub n (2) = 4hfR (exp(hf/kT) - 1)) where anti e sub n (2) has the units volts squared per unit frequency, and h and k are the Planck and Boltzmann constants, respectively, f is the frequency in hertz (Hz) and T is the absolute temperature in Kelvins (K). J. B. Johnson showed that the noise was independent of the composition of the resistor. These discoveries gave rise to a temperature measurement technique using the Johnson noise voltage and Johnson noise current in a noise power mode, which essentially gives immunity to the decalibrating effects of radiation-induced transmutations of the temperature-sensing element. Experiments were conducted in which temperature measurements were made in the range from 300 to 1200 K. Extrapolation of plots of these data pass through absolute zero, as expected. In-pile irradiation experiments show no perceptible decalibration after 4500 h in high neutron flux even though 80 percent of the original sensor material, rhenium, was transmuted to osmium. DOE

N88-24481# Pacific Northwest Labs., Richland, Wash.
MOLYBDENUM-BASE CERMET FUEL DEVELOPMENT
James P. Pilger, William E. Gurwell, Ronald W. Moss, George D. White, and David A. Seifert (Battelle Columbus Labs., Ohio.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 521-526 Previously announced as N88-21003 (For primary document see N88-24374 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A99/MF A01

Development of a multimegawatt (MMW) space nuclear power system requires identification and resolution of several technical feasibility issues before selecting one or more promising system concepts. Demonstration of reactor fuel fabrication technology is required for cermet-fueled reactor concepts. The MMW reactor fuel development activity at Pacific Northwest Laboratory (PNL) is focused on producing a molybdenum-matrix uranium-nitride (UN) fueled cermte. This cermet is to have a high matrix density (greater than or equal to 95 percent) for high strength and high thermal conductance coupled with a high particle (UN) porosity (approximately 25 percent) for retention of released fission gas at high burnup. Fabrication process development involves the use of porous TiN microspheres as surrogate fuel material until porous Un microspheres become available. Process development was conducted in the areas of microsphere synthesis, particle sealing/coating, and high-energy-rate forming (HERF) and the vacuum hot press consolidation techniques. This paper summarizes the status of these activities. DOE

N88-24482# Idaho National Engineering Lab., Idaho Falls.
TEST PLAN AND FACILITIES FOR QUALIFYING NUCLEAR ROCKET FUEL ELEMENTS **c20**
Zoel R. Martinson and Jack H. Ramsthaler *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 529-533 Sponsored in part by Air Force Astronautics Lab., Edwards AFB, Calif. (For primary document see N88-24374 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A99/MF A01

The key to a successful nuclear rocket program will be developing and qualifying fuel elements in relatively low-cost, small-scale test facilities that can meet environmental and safety criteria. An approach for meeting this objective with existing facilities and viable cost is outlined. Only after the selected fuel concept is thoroughly proven should engine flight qualification be attempted. It is recommended that the initial engine flight qualification be performed at low power and low flow prior to confirmatory qualification in space. Author

N88-24483# Texas A&M Univ., College Station. Advanced Nuclear Fuels Lab.
MATERIAL PROPERTY AND IRRADIATION PERFORMANCE CORRELATIONS FOR NITRIDE FUELS **c28**
J. Kelly Thomas, Dan E. Brozak, Steven L. Hayes, and K. Lee Peddicord *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 535-541 (For primary document see N88-24374 17-73)
(Contracts DE-AC02-86NE-37960; LANL-9-X6D-1878G-1; LANL-9-X6D-1879G-1)
Avail: NTIS HC A99/MF A01

Correlations developed for thermal conductivity, electrical resistivity, fuel swelling, and fission gas release of uranium nitrides

(UN) were presented. Nonlinear correlation forms were selected on the basis of correlation stability outside the range of available data. The correlations were in very good agreement with the data, and, in general, appear to be an improvement over existing correlations. Work is continuing towards the development of a complete set of UN property correlations. The data base used to develop the irradiation behavior correlations will be expanded so that improved irradiation behavior correlations can be produced. Additionally, alternative correlation expressions for fuel swelling and fission gas release are being investigated. Author

N88-24484# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
SNAP FUEL PERFORMANCE
John P. Page *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 543-545 (For primary document see N88-24374 17-73)
(Contract AT(04-3)-701)
Avail: NTIS HC A99/MF A01

Proven technology exists for the design and fabrication of U-ZrH(x) fuel elements for use in the 50 to 250 kWt reactors proposed for space power applications. Hydrogen loss through the cladding is low and can be compensated for by providing reasonable excess reactivity at start of life along with the inclusion of burnable poisons. Cladding integrity will be maintained since the growth rate of the fuel rods will not be excessive at the anticipated fuel temperatures and with the ZrH(x) maintained in the delta phase. Author

N88-24485# New Mexico Univ., Albuquerque. Inst. for Space Nuclear Power Studies.
A COMPARISON OF URANIUM NITRIDE AND MIXED CARBIDE FUELS SWELLING
Steven B. Ross, Mohamed S. El-Genk, and R. Bruce Matthews (Los Alamos National Lab., N. Mex.) *In its* Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 547-551 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The current analysis demonstrated that both uranium nitrides (UN) and (U,Pu)C fuels have similar swelling behavior at temperatures of up to 1600 K. However, at maximum fuel temperatures higher than 1600 K but below 2000 K, the mixed carbide fuel swelling is higher than that for UN. The comparison of the mixed carbide fuel swelling data of Zimmermann (1982) with that of the Los Alamos K-7 and K-9 series demonstrates the applicability of Zimmermann's correlation for mixed carbide fuel for predicting fuel swelling at higher burnup values up to 16 atom percent and at temperatures below 2000 K. The results suggest that mixed carbide fuel and UN fuel have similar swelling behavior up to 1600 K. Examination of the carbide data base of LANL and Zimmermann showed no evidence of breakaway swelling above 1400 K. Author

N88-24486# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
SNAP-DYN: CONCEPTS FOR MULTIKILOWATT SPACE POWER APPLICATIONS
W. R. Determan *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 553-556 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The SNAP-DYN power system was reviewed to characterize the system size, mass, and efficiency in the 10 to 50 kWe power range. All of the major component technologies for this system concept, including deployment, were developed or are under development for the Space Station. The DIPS technology is directly applicable to the concept in the areas of power system reliability and survivability. The SNAP-DYN concept is a truly state-of-the-art system for use in future military and civilian space power programs. Author

N88-24487# Babcock and Wilcox Co., Lynchburg, Va.
SMALL PARTICLE BED REACTORS: SENSITIVITY TO BRAYTON CYCLE PARAMETERS
John R. Coiner and Barry J. Short *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 557-560 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Relatively simple particle bed reactor (PBR) algorithms were developed for optimizing low power closed Brayton cycle (CBC) systems. These algorithms allow the system designer to understand the relationship among key system parameters as well as the sensitivity of the PBR size and mass (a major system component) to variations in these parameters. Thus, system optimization can be achieved. Author

N88-24488# Garrett Fluid Systems Co., Tempe, Ariz.
THE CLOSED BRAYTON CYCLE: AN ENERGY CONVERSION SYSTEM FOR NEAR-TERM MILITARY SPACE MISSIONS c44
Keith A. Davis *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 561-564 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

The Particle Bed Reactor (PBR)-closed Brayton cycle (CBC) provides a 5 to 30 kWe class nuclear power system for surveillance and communication missions during the 1990s and will scale to 100 kWe and beyond for other space missions. The PBR-CBC is technically feasible and within the existing state of the art. The PBR-CBC system is flexible, scaleable, and offers development economy. The ability to operate over a wide power range promotes commonality between missions with similar but not identical power spectra. The PBR-CBC system mass is very competitive with rival nuclear dynamic and static power conversion and systems. The PBR-CBC provides growth potential for the future with even lower specific masses. Author

N88-24489# Sandia National Labs., Albuquerque, N. Mex.
THE EFFECT OF OPERATING TEMPERATURE AND TURBINE BLADE COOLING ON BRAYTON CYCLE SPACE POWER SYSTEMS c44
Michael W. Edenburn *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 565-570 (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01

Systems analyses were performed to evaluate multimegawatt (MMW) space power systems and to help determine which areas of technical development should receive emphasis. Results are presented from a part of the system evaluation work that deals with MMW, Brayton cycle, and space power systems. How turbine inlet temperature and turbine blade cooling affect the mass of a Brayton space power system using a nickel superalloy turbine is quantified. The effect that turbine inlet temperature has on a system mass when uncooled molybdenum refractory metal and uncooled carbon turbines are used is examined. The use of blade cooling for superalloy turbines does not allow turbine inlet temperatures much beyond the normal material temperature inlet, because blade cooling reduces cycle efficiency. The use of carbon turbines promises to substantially reduce the mass of state systems, but carbon turbines will require substantial development effort. B.G.

N88-24490# Pacific Northwest Labs., Richland, Wash.
A COMBINED RANKINE/BRAYTON PULSE POWER CYCLE c44
Edmund P. Coomes, Benjamin M. Johnson, and Herbert J. Bomelburg *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 571-574 (For primary document see N88-24374 17-73)
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A99/MF A01

Mixed fluid Ljungstrom turbines using hydrogen and potassium vapor appear to be feasible. There appears to be a considerable degree of freedom in the design of the turbine. Optimization studies

would probably result in different state points being selected to obtain minimum size and mass of the components. Studies have shown, however, that the apparent design sizes of the turbine components are well within acceptable limits. The resultant component weights are probably markedly lower than those for a simple Brayton system because of the use of the compact liquid metal cooled reactor as the source of heat and a direct contact heat exchanger. Author

N88-24491*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FATIGUE FAILURE OF REGENERATOR SCREENS IN A HIGH FREQUENCY STIRLING ENGINE **c38**
David R. Hull, Donald L. Alger, Thomas J. Moore, and Coulson M. Scheuermann *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 575-578 Previously announced as N87-18882 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 14D

Failure of Stirling Space Power Demonstrator Engine (SPDE) regenerator screens was investigated. After several hours of operation the SPDE was shut down for inspection and on removing the regenator screens, debris of unknown origin was discovered along with considerable cracking of the screens in localized areas. Metallurgical analysis of the debris determined it to be cracked-off-deformed pieces of the 41 micron thickness Type 304 stainless steel wire screen. Scanning electron microscopy of the cracked screens revealed failures occurring at wire crossovers and fatigue striations on the fracture surface of the wires. Thus, the screen failure can be characterized as a fatigue failure of the wires. The crossovers were determined to contain 30 percent reduction in wire thickness and a highly worked microstructure occurring from the manufacturing process of the wire screens. Later it was found that reduction in wire thickness occurred because the screen fabricator had subjected it to a light cold-roll process after weaving. Installation of this screen left a clearance in the regenerator allowing the screens to move. The combined effects of the reduction in wire thickness, stress concentration (caused by screen movement), and highly worked microstructure at the wire crossovers led to the fatigue failure of the screens. Author

N88-24492# New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
ENERGY CONVERSION SYSTEM OPTIMIZATION STUDY FOR MULTIMEGAWATT SPACE NUCLEAR POWER APPLICATION **c44**
Alexander G. Parlos, Mohamed S. El-Genk, John M. McGhee, David Buden, and Jim Mims (Science Applications International Corp., Albuquerque, N. Mex.) *In its* Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 579-582 (For primary document see N88-24374 17-73)
(Contract DE-AC03-86SF-16508)
Avail: NTIS HC A99/MF A01

An energy conversion system optimization study followed by an overall power system parametric analysis was performed in response to the multimegawatt power needs of some of the SDI missions during both alert and burst modes of operation. The study of the energy conversion system revealed that for the power ranges under consideration, the potassium Rankine cycle system is superior to the closed loop Brayton cycle system, but competitive with the open loop Brayton cycle system. In addition, it was verified through extensive computer simulations that the combined burst/alert mode radiator is indeed the most massive component of the energy conversion system and, in fact, of the overall power system. Author

N88-24493# Argonne National Lab., Ill.
AUTOMATIC REACTOR CONTROL SYSTEM FOR TRANSIENT OPERATION
Walter C. Lipinski, Samit K. Bhattacharyya, and Nelson A. Hanan *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 583-588 (For primary document see N88-24374 17-73)
(Contract W-32-109-eng-38)
Avail: NTIS HC A99/MF A01

Various programmatic considerations have delayed the upgrading of the TREAT reactor and the performance of the control system is not yet experimentally verified. The current schedule calls for the upgrading activities to occur last in the calendar year 1987. Detailed simulation results, coupled with earlier validation of individual components of the control strategy in TREAT, verify the performance of the algorithms. The control system operates within the safety envelope provided by a protection system designed to ensure reactor safety under conditions of spurious reactivity additions. The approach should be directly applicable to MMW systems, with appropriate accounting of temperature rate limitations of key components and of the inertia of the secondary system components. Author

N88-24494# Massachusetts Inst. of Tech., Cambridge. Nuclear Reactor Lab.
EXPERIMENTAL EVALUATION OF THE MIT-SNL PERIOD-GENERATED MINIMUM TIME CONTROL LAWS FOR THE RAPID ADJUSTMENT OF REACTOR POWER
John A. Bernard, Kwan S. Kwok, Paul T. Menadier, Frank V. Thome, and Francis J. Wyant (Sandia National Labs., Albuquerque, N. Mex.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 589-594 (For primary document see N88-24374 17-73)
(Contract DE-AC02-86NE-37962)
Avail: NTIS HC A99/MF A01

The rapid adjustment of reactor neutronic power was recently achieved by developing control laws that determine the actuator mechanism velocity necessary to produce a specified reactor period. Designated as the MIT-SNL Period-Generated Minimum Time Control Laws, these relations are closed-form expressions of general applicability. The objectives are: to describe the experimental program that was undertaken to evaluate these period-generated control laws on actual reactors; to report the results; and to discuss the significance of these experiments. B.G.

N88-24495# Texas A&M Univ., College Station. Dept. of Nuclear Engineering.
AN OPTIMAL DISTURBANCE REJECTION CONTROL SYSTEM FOR MULTIMEGAWATT SPACE NUCLEAR POWER SYSTEMS **c63**
Alexander G. Parlos *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 595-598 Sponsored in part by NSF, Washington, D.C. and MIT, Cambridge (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

A systematic control system design methodology, namely the Set-Theoretic algorithm, is used for the automatic control of a multimegawatt (MMW) type space nuclear power system. The main advantage in using any systematic control system design method is that it provides results which are independent of the specific dynamic system examined. In addition, the approach followed possesses several advantages including the explicit treatment of state, control, and control rate constraints which must be strictly enforced for safety purposes in nuclear systems, as well as the ability to model the demanded load as a ubb disturbance, since it is desirable to respond successfully to highly uncertain pulse profiles. Transient response simulations showed that the space nuclear power system under consideration can be brought from alert mode power levels up to burst mode power levels in reasonably short time periods, without violating vital constraints placed upon the system because of safety considerations. Author

N88-24496# Westinghouse Hanford Co., Richland, Wash.
SP-100 GROUND ENGINEERING SYSTEMS TEST FACILITY CONTROL SYSTEMS **c14**
William F. Carlson *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 601-603 (SEE

N88-24374 17-73) 1988 (For primary document see N88-24374 17-73)
(Contract DE-AC06-87RL-10930)
Avail: NTIS HC A99/MF A01

Modern microprocessor-based control system technology is being utilized in this facility to provide the flexibility and human factors features required for safe, reliable testing of a space nuclear reactor and some of its supporting systems. The specifications for the control system are being written so as to procure a complete system which was proven in other plants, therefore minimizing procurement time and development costs. The flexibility of such a system will make it possible to adapt quickly to changing test requirements during the life of the facility. Author

N88-24497# New Mexico State Univ., Las Cruces. Dept. of Mechanical Engineering.
ENERGY OPTIMAL TRAJECTORY PLANNING FOR ROBOT MANIPULATORS AND AUTONOMOUS VEHICLES **c37**
Richard D. Colbaugh and Keith L. Phillips *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 605-610 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

A unified approach to the solution of energy-optimal trajectory planning problems for robots was presented. The method is based on a reformulation of the energy objective function and on a computationally efficient use of the calculus of variations with equality and inequality constraints. This approach, although still in the developmental stage, was successfully applied to path planning for both nonredundant and redundant robot manipulators in pick and place and Cartesian trajectory tracking applications. Additionally, preliminary study indicates that the method is well-suited for mobile robot trajectory planning. Future research will involve the completion of the development of the method and then the application of the method to a wide range of real-time, energy-optimal control problems, with particular emphasis directed to space applications. Author

N88-24498# Rasor Associates, Inc., Sunnyvale, Calif.
TRICE DESIGN, EVALUATION AND FEASIBILITY TESTS
H. E. Huey, J. B. McVey, T. P. Sahines, and R. C. Cooper *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 611-613 Sponsored by the Strategic Defense Initiative Organization, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

A thermionic reactor with inductively coupled elements (TRICE) concept was described. To estimate the attainable range and relative merit of the TRICE system performance, and to provide guidance for goals and constraints of the TRICE converter research, a parametric computer model of a thermionic reactor system with one or more modules was prepared. The methodology is similar to that used by the NASA/DOE Independent Evaluation Group (IEG) for the examination and comparison of MMW systems for SDI applications. The total systems performance is computed in terms of mission requirements and major design parameters. The advantages and disadvantages with respect to the qualitative aspects of the concepts are identified. The computational model is derived from a system performance computer program Nuclear Optimization Program (NOP), for the evaluation of advanced space power supplies. The computer model for the TRICE converter performance and the constraints for the reactor configuration were incorporated in NOP. Author

N88-24499# Westinghouse Electric Corp., Madison, Pa. Advanced Energy Systems Div.
ALKALI METAL THERMOELECTRIC CONVERTER DESIGN FOR SPACE POWER SYSTEMS APPLICATIONS **c44**
Robert K. Sievers, Robert A. Markley, J. Edward Schmidt, Neill Weber, James R. Rasmussen, Scott Olsen, and Thomas K. Hunt (Ford Motor Co., Dearborn, Mich.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 615-618 (For primary document see N88-24374 17-73)
(Contract DE-AC03-86SF-16503)
Avail: NTIS HC A99/MF A01

The low specific mass of this stacked vapor fed alkali metal thermoelectric converter (AMTEC) module make it an attractive concept for space power applications. Several key design issues must be resolved in future development efforts. These issues involve the development of a reliable insulator for the electrical leads and transition pieces to join the BASE tubes. These components must provide a hermetic seal at the high operating temperatures of this system. The insulators must also provide electrical isolation for the electrical leads. Designs were identified to meet these requirements but are not tested at present. Author

N88-24500# Thermacore, Inc., Lancaster, Pa.
A CAPILLARY PUMPED SHE/AMTEC SYSTEM **c44**
Donald M. Ernst *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 619-620 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

A Sodium, Heat Engine/Alkali Metal Thermoelectric Converter (SHE/AMTEC) design which employs a capillary structure for collecting and recirculating the sodium working fluid is proposed. The overall system design is presented and discussed. The proposed design offers a self-contained, compact, low mass, self pumped energy conversion system that is usable with many alternate fuel/heat sources and is especially suitable for space use. B.G.

N88-24501*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HIGH POWER DENSITY ELECTRODES FOR AMTEC **c33**
C. Perry Bankston, Roger M. Williams, Barbara Jeffries-Nakamura, Mark L. Underwood, and Terry Cole *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 621-623 Sponsored in part by Strategic Defense Initiative Organization, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 09C

Trilayer tungsten/platinum electrodes have provided dramatic improvements in stable power densities in alkali metal thermoelectric converters (AMTEC) experimental cells. The specific power density required to achieve a system conversion efficiency of approximately 15 percent or more with temperatures appropriate to space nuclear power sources is examined. Thus, if the observed power densities are sustained for thousands of hours, prototype AMTEC space nuclear power systems can be designed and tested. Author

N88-24502# Ford Motor Co., Dearborn, Mich.
PERFORMANCE OF VAPOR-FED SODIUM HEAT ENGINE/AMTEC SYSTEMS **c44**
Robert F. Novak, James R. McBride, and Thomas K. Hunt *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 625-628 (For primary document see N88-24374 17-73)
(Contract DE-AC02-83CE-40651)
Avail: NTIS HC A99/MF A01

Design studies have indicated that for high power space applications, operation of Sodium Heat Engine/Alkali Metal Thermoelectric Converter (SHE/AMTEC) systems in a vapor-fed mode is desirable. The experiments reported show that the operation in the vapor-fed mode is feasible, that appropriate lead conductances can be achieved with proper handling of the condensing liquid sodium layer and that acceptable power density levels can be reached. Author

N88-24503*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
IMPROVED GaP DOPED SiGe THERMOELECTRIC MATERIAL **c44**
Jan W. Vandersande, Charles Wood, Susan L. Draper, Valvo Raag,

Michael Alexander, and Richard Masters (Thermo Electron Corp., Waltham, Mass.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 629-632 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 10A

Work at TECO has independently confirmed the early results obtained at JPL that high-temperature heat-treatment of SiGe/GaP alloys can significantly increase the figure of merit Z of these alloys. Several possible reasons for this improvement are given. Experiments are in progress to test these various hypothesis.
Author

N88-24504# Sandia National Labs., Albuquerque, N. Mex.
MULTIMEGAWATT POWER CONDITIONING REQUIREMENTS STUDY **c44**
David T. Furgal and William H. McCulloch *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 637-641 (For primary document see N88-24374 17-73)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A99/MF A01

An initial study was conducted to identify and document power conditioning circuit topologies for the electromagnetic launcher, neutral particle beam, and free-electron laser weapon systems. This study focused on the elements within the weapon systems that consume the bulk of the platform prime power during the burst mode. Possible approaches for conditioning prime power and delivering it in a form needed by the major weapon system loads were identified. Based on current projections of power conditioning and weapon system component performance, efficiency ranges for power trains were estimated. Organizations tasked with providing detailed weapon system power conditioning concepts must be cognizant of all of the weapon system power requirements and not only those of the major power consumers. Therefore, power conditioning component data in the study document include as much detail as possible on component electrical characteristics.
Author

N88-24505# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
LIGHTWEIGHT POWER BUS FOR A BASELOAD NUCLEAR REACTOR IN SPACE **c33**
Lowell D. Massie, Dennis J. Hoffman, and Charles E. Oberly *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 643-646 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

Metallic superconductors requiring refrigeration in the range of 4 to 10 K are of no benefit to the baseload space power system bus because the refrigeration and insulation constraints are too severe. The ceramic superconductors that can operate in the range of 20 to 100 K alleviate a great deal of the refrigeration problem and can compete with conventional hot bus distribution systems on the basis of mass for a bus exceeding a few meters in length. The ultimate benefit of the superconducting bus to the space power system will not be the mass savings. The great benefit of the superconducting bus will be the enormous reduction in bus voltage requirements due to the zero voltage drop along the bus. Low bus voltage (less than 100 Vdc) will permit a conventional dielectric insulation technology to be utilized as baseload powers are forced above 10 kW on spacecraft.
Author

N88-24506*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE POWER RADIATION COOLED dc TRANSMISSION LINE ANALYSIS **c33**
Gene E. Schwarze *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 649-653 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 09C

The results of this analysis show that both mass and percent power loss reductions result from an increase in source voltage. A decrease in conductor diameter also leads to reduced mass, but this decrease gives higher percent power losses since the operating temperature increases. The results also show that increasing the source voltage beyond a certain limit for a fixed operating temperature only gives minimal decreases in both the mass and the percent power loss; likewise, the results show that decreasing the diameter below a certain point for a fixed voltage causes minimal decreases in the mass but excessive percent power losses and thus high operating temperatures. The plots generated by using the mathematical results derived in this analysis clearly show when these diminishing mass reductions and excessive operating temperatures occur. Depending on the mission objectives, a trade-off between mass, diameter, and percent power loss in terms of voltage, operating temperature, and conductor material will most likely be required when the total power system is considered. Thus, the results of this analysis should aid the system designer in conducting these trade studies with respect to the performance characteristics of a radiation cooled dc transmission line.
Author

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N88-24507# Rochester Univ., N. Y. Lab. for Laser Energetics.
AIR FORCE ULTRAFAST OPTICAL ELECTRONICS CENTER Annual Report, 1 Nov. 1986 - 31 Oct. 1987
G. Mourou 1987 24 p
(Contract F49620-87-C-0016)
(AD-A191491; AFOSR-88-0024TR) Avail: NTIS HC A03/MF A01 CSCL 20F

The general objective of the AFOSR URI Center at Rochester is to investigate the physics of electronic microstructures using ultrafast optical techniques. To achieve this goal, we have developed and improved state-of-the-art laser sources and diagnostic techniques so that optical or electrical measurements could be performed with unprecendented temporal resolution, typically in the picosecond or femtosecond domain.
GRA

N88-24508*# National Aeronautics and Space Administration. Pasadena Office, Calif.
DYNAMIC RANGE COMPRESSION/EXPANSION OF LIGHT BEAMS BY PHOTOREFRACTIVE CRYSTALS Patent Application
Li-Jen Cheng, inventor (to NASA) and Hua-Kuang Liu, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 24 Nov. 1987 14 p
(Contract NAS7-918)
(NASA-Case-NPO-17140-1-CU; NAS 1.71:NPO-17140-1-CU; US-Patent-Appl-SN-125021; JPL-17140) Avail: NTIS HC A03/MF A01 CSCL 20F

An apparatus is provided which greatly reduces the intensity of bright portions of an image while only moderately reducing the brightness of dimmer portions of the image, to thereby compress the range of light intensities to facilitate detection of the image. The apparatus includes a light detector device formed by a chip of photorefractive material. A two-dimensional array of light beams from an object to be detected passes through a beam splitter to form two arrays of light beams. The two arrays of light beams are directed at different angles against a surface of the chip of photorefractive material, the two arrays of light beams forming coincident images on the surface. One of the two-dimensional arrays of beams emerging from an opposite surface of the chip has a lower range of intensities, to facilitate detection of the object despite very bright spots in its image. The other array of light beams emerging from the chip has a greater range of intensities than the unprocessed image of the object.
NASA

N88-24509# Institut National Polytechnique, Grenoble (France). Lab. d'Electromagnetisme.
ENHANCEMENT OF SECOND HARMONIC GENERATION ON SILVER GRATINGS BY RESONANT EXCITATION OF SURFACE PLASMON Ph.D. Thesis
Jean Louis Coutaz 1987 175 p In FRENCH; ENGLISH summary
(ETN-88-92304) Avail: NTIS HC A08/MF A01

It is shown how the efficiency of optical second harmonic generation on metal surfaces can be increased by the excitation of surface plasmon. This phenomenon can be described by the theory of nonlinear optical diffraction which predicts that there exists an optimum groove depth of the grating for which the enhancement of the nonlinear phenomenon is the greatest. Results of experiments of second harmonic generation on silver gratings agree closely to the predictions of the theory. By comparison with a flat silver mirror, an enhancement of 2500 using a grating with 5 percent groove depth modulation is measured. ESA

N88-24510 New South Wales Univ., Sydney (Australia).
NOVEL SILICON SCHOTTKY BARRIER INFRARED IMAGING ARRAYS Ph.D. Thesis Abstract Only
Jerzy Mieczyslaw Kurianski Jun. 1987 199 p
Avail: Issuing Activity

Silicon infrared (IR) imaging alloys normally consist of separate IR Schottky silicide detectors connected to conventional, metal-oxide-silicon (MOS) type, charge-coupled-device (CCD) shift registers. The IR image signal charge is generated and stored in the Schottky detectors and subsequently read-out serially by means of CCD shift registers. Schottky IR detectors with Pd and Pt used for the silicide formation were characterized. A computer modeling program was developed for optimization of the silicide detector optical cavity. The theoretical and experimental data generated during this optimization procedure are presented. A conventional IR CCD line array was developed, and elements of the line array design and of the fabrication sequence were used later in the work done on the Schottky element arrays. The application of a mask level butting technique to the design of this conventional device enabled the realization of an uninterrupted IR imaging CCD line array incorporating 1024 detectors. A computerized CCD measurement system used for the testing of devices was designed, built, and the software written to accommodate driving requirements for various types of CCD devices. Author

N88-24511 New South Wales Univ., Kensington (Australia).
INTERACTION OF SOLITONS IN SINGLE MODEL OPTICAL FIBRES Ph.D. Thesis Abstract Only
Can Desem Mar. 1987 216 p
Avail: Issuing Activity

If two identical solitons are launched into an optical fiber, they are initially attracted to each other, forming an oscillating system where the two pulses periodically coalesce to form one pulse and then separate. A superior way to minimize the interactions is to launch the adjacent pulses with different amplitudes. The pulse coalescence is avoided and a bound system of solitons is formed where the solitons deviate from their relative positions periodically by only a small fraction of their initial separation. It is also shown that increasing the initial amplitude of the pulses can lead to a delay of the pulse coalescence distance. Their delay can be further lengthened if Gaussian rather than sech pulses are used. A realistic soliton communication system needs periodic amplification to overcome the fiber loss. It is shown that in this case additional transmission instabilities will arise due to the mutual interaction of solitons. However, stable propagation is still possible when pulses with unequal amplitudes are used. A study is presented where the interaction of more than two solitons is considered. It is shown that the use of unequal amplitude solitons can lead to a reduction of the interaction if the initial symmetry of the pulse waveform is avoided. The effect of chirping on the propagation and interaction of solitons is also studied. Author

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N88-24512# Nagoya Univ. (Japan). Inst. of Plasma Physics.
SUMMARY REPORT ON THE JAPAN-US WORKSHOP ON THE ASSESSMENT OF SPECTROSCOPIC DATA FOR TEMPERATURE AND DENSITY MEASUREMENTS
W. L. Wiese, ed. (National Bureau of Standards, Gaithersburg, Md.) and J. Fujita, ed. Mar. 1988 51 p Workshop held in Nagoya, Japan, 18-20 Mar. 1987
(IPPJ-861; ISSN-0469-4732) Avail: NTIS HC A04/MF A01

Papers addressing various plasma diagnostic subjects were presented with special consideration given to spectroscopic data issues, data needs, availability and data adequacy. Specific topics included X-ray spectroscopy, VUV and visible region spectroscopy, plasma edge spectroscopy, polarization spectroscopy, charge-exchange spectroscopy, excitation rate data, spectral radiometry and spectroscopic data tables. The program of the workshop and abstracts of the papers are given along with summaries of the findings and recommendations of small group sessions. For individual titles, see N88-24513 through N88-24534.

N88-24513# Japan Atomic Energy Research Inst., Ibaraki. Fusion Research Establishment.
ION TEMPERATURE MEASUREMENT WITH SPECTROSCOPY IN JT-60 Abstract Only
Akira Sakasai, Yoshihiko Koide, Hirotaka Kubo, Tatsuo Sugie, Nobuo Akaoka, Toshio Hirayama, and Hiroshi Takeuchi *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 3 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

In the JT-60, the center-region ion temperature is measured by a 2.5 m Johann type crystal spectrometer which has two crystals: Si (220) for the Ti K-alpha line and SiO2 (2243) for the Ni K-alpha line. The peripheral-region ion temperature is measured by a 1.2 m normal incidence vacuum ultraviolet (VUV) spectrometer. X-ray spectra of the resonance line and satellite lines of He-like titanium, Ti XXI, and the resonance lines of hydrogen-like titanium, Ti XXII, are observed by the crystal spectrometer which has a multichannel detector. The resonance and satellite lines of He-like nickel, Ni XXVII, is observed with an X-ray spectrogram. The Doppler broadening measurement of the resonance lines of titanium determines the ion temperature of the off-center region for the neutral beam injection (NBI) heated plasma compared with the ohmically heated plasma. The maximum ion temperature measured in the NBI experiment was 6 keV. The ratios of satellite lines to the resonance line of Ti XXI give information on electron temperature and density, ionization equilibria and fractional population of nonthermal electrons. Vacuum ultraviolet spectroscopy is applied to measure the lines of highly ionized light impurities and the forbidden lines of metal impurities. The Doppler broadening of these lines is measured to a higher order by the normal incidence VUV spectrometer. Author

N88-24514# Princeton Univ., N. J.
X-RAY EMISSION FROM TOKAMAKS Abstract Only
S. vonGoeler, P. Beiersdorfer, M. Bitter, K. Hill, and H. Hsuan *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 4 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

The attainment of ion temperatures in the 20 keV region in supershots on the TFTR tokamak deduced from X-ray and vacuum ultraviolet Doppler broadening measurements has demonstrated the importance of spectroscopic techniques for controlled thermonuclear fusion research. A survey of the present status of investigation of the spectral emission in the X-ray region is presented. Special emphasis is placed on new results and

unresolved problems. The survey covers the important n = 2 to 1 transitions, i.e., hydrogen-like and helium-like spectra, and also n = 3 to 2 transitions, especially neon-like spectra, which have been studied intensively in recent years. In addition, the important diagnostic applications of X-ray spectroscopy like ion temperature measurements or impurity transport studies are also discussed. Of these applications, the measurement of plasma rotation velocities has become very important, because supershots require balanced injection. Author

N88-24515# Nagoya Univ. (Japan). Inst. of Plasma Physics.
X-RAY SPECTROSCOPIC DIAGNOSTICS ON JIPPT-IIU AND HELIOTRON-E Abstract Only
Shigeru Morita *In its* Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 5 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

Activities in X-ray spectroscopy at the Institute of Plasma Physics are reported with an emphasis on Ti K-alpha measurements. Two crystal spectrometers of Johann type (wide spectral band spectrometer with small Rowland circle and high resolution spectrometer with large Rowland circle) were constructed for X-ray diagnostics of the JIPPT-IIU tokamak plasma. The detector is a position-sensitive proportional counter (PSPC). A wide spectral band spectrometer was made for measuring a full spectrum of K-alpha transitions. The K-alpha full spectra are obtained in experiments with both lower-hybrid current drive (LHCD) and ion cyclotron radio frequency (ICRF) heating. In LHCD experiments, nonthermal features of Ti K-alpha lines are observed at electron densities below approximately 5 x 10(12) cm(-3). The measured Ti spectra are analyzed under simply assumed radial profiles of nonthermal electrons. In ICRF experiments, time behaviors of Ti, Cr, Fe and Ni K-alpha spectra are measured with time intervals of 10 ms to study the impurity transport. A high-resolution spectrometer was made to measure the ion temperature, electron temperature, toroidal rotation and quantitative contribution of nonthermal electrons. In the ion temperature measurement, narrowing of the Ti He-like resonance line is observed during ohmic heating. The full K-alpha spectra from Ti and Fe ions were also observed in Heliotron-E ICRF and electron cyclotron heating experiments. Most abundant ion species in the central column of the plasma were determined. Author

N88-24516# Nagoya Univ. (Japan). Inst. of Plasma Physics.
HELIUM-LIKE TITANIUM SPECTRA FROM TOKAMAK PLASMAS Abstract Only
Takako Kato *In its* Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 6 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

Time resolved measurements of Ti XXI to Ti XIX X-ray line spectra from an ohmically heated plasma with neon puffing in the JIPPT-IIU tokamak were analyzed. The spectral analysis was done using a collisional radiative model which includes the cascade contributions from highly excited states as well as the recombination processes. The observed spectra were fitted with synthetic calculations taking all possible lines into account. The result indicates that the plasma is in an ionizing phase at the beginning, reaches nearly an equilibrium around 80 ms and then turns into a recombination phase thereafter following the decrease of the electron temperature. The observed intensity ratios I(x)/I(w) and I(y)/I(w) were always found to be more than twice as large as the theoretical ones. The discrepancies increased in the later period of the plasma after T(e) decreased. The contribution of ion-ion charge exchange processes (between neon and titanium ions) on the ion abundances and line intensities was investigated. The correlation between the He-like forbidden line I(z) and the Li-like satellite line I(q) were studied. The observed intensities are applied to these correlations and the plasma conditions are discussed. Author

N88-24517# Joint European Torus Project, Abingdon (England).
SPECTROSCOPIC RESULTS FROM JET: SOME EXAMPLES OF DATA COMPARISON AND DATA NEEDS Abstract Only
E. Kaelline *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 2 p (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

The spectroscopic techniques presently used in the JET tokamak include wideband wavelength and spatial scans in the vacuum ultraviolet (VUV), high resolution instruments in both the VUV and X-ray region, fast imaging and energy selective X-ray and total radiation systems. An effort is underway to combine the analysis of results from these various spectroscopic systems. Preliminary conclusions show that, in order to describe the X-ray spectroscopy results, it is necessary to invoke larger abundances of Li-, Be- and B-like ions (by factors of 2 to 3) in the center of the plasma than predicted with an ionization equilibrium model including transport coefficients. Furthermore, these results have an analogy in the observations of the total X-ray emission where possible hollow impurity profiles or radial dependencies of transport coefficients need to be included to describe the observed data. Additionally, the observations of radial profiles in the VUV show the need for similar assumptions. The comparison of different spectroscopic techniques has thus indicated the need for a careful analysis of available atomic physics data for ionization equilibrium as well as a call for more experimental data with an emphasis on radial profiles in order to better understand the influence of particle transport and possible radial dependencies in the parameters important for particle transport. Author

N88-24518# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ION TEMPERATURE PROFILE MEASUREMENT USING CHARGE EXCHANGE RECOMBINATION SPECTROSCOPY ON JIPP T-IIU Abstract Only
T. Ozaki *In its* Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 7 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

The use of charge exchange spectroscopy with neutral beam heating for obtaining the ion temperature profile, the plasma rotation and the beam deposition in the JIPPT-IIU tokamak is discussed. Fully ionized carbon and oxygen atoms are widely distributed in the plasma so that plasma parameters in the plasma center can be obtained. The heating hydrogen beam (33 keV, 30 A, 900 kW) was almost radially injected. The viewing arrangement was tangentially set for observing the radial variation of plasma parameters. The light was transported to the Czerny-Turner spectrometer using a quartz fiber of 20 m and spectral lines were detected by the photodiode array. The DARSS system was used as the data accumulation and processing system. A typical ion temperature of 820 eV at the plasma center was obtained from Doppler broadenings of both the C and O lines when ohmic and neutral beam heating was applied, and 1.6 keV was observed when additional ion cyclotron resonance heating was applied. The ion temperature profile could be approximated by the quadratic curve. These results were in good agreement with the results of other diagnostic measurements (fast neutral particle analysis, X-ray crystal spectroscopy, and neutron measurements). The results of the plasma rotation and beam energy reduction are also discussed. Author

N88-24519# GA Technologies, Inc., San Diego, Calif.
SPECTROSCOPIC MEASUREMENTS OF ION TEMPERATURE, ROTATION SPEED AND BEAM DEPOSITION PROFILE ON DIII-D Abstract Only
R. J. Groebner, K. H. Burrell, and R. P. Seraydarian *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 8 (For primary document see N88-24512 17-75)

(Contract DE-AC03-84ER-51044)
Avail: NTIS HC A04/MF A01

Two eight-chord spectrometers, one with a vertical view and one with a tangential view, are being implemented on the DIII-D tokamak to measure ion temperature profiles T(i)r and rotation velocity profiles V(r)r via charge exchange recombination (CER) between neutrals in an 80 keV heating beam and plasma impurities. Based on the success of a similar instrument on the Doublet III tokamak, the primary lines of interest are O VIII 2975 A and He II 4686 A. C VI is also a desirable candidate but has proven difficult to use due to a bright component excited by electron impact or CER with thermal neutrals. A single chord, spatially-scannable spectrometer (1400 to 3000 A coverage) will be used primarily to obtain near edge T(i) and V(r) measurements from C V 2271 A, O V 2781 A, and O VII 1623 A. Any available magnetic dipole lines of intrinsic Ni, Cr and Fe will also be used. The spatial location of the lines will be measured by another instrument with a rapidly vibrating, spatially-scanning mirror. These instruments will also be used to study the beam deposition profile by examining the relative intensities of the three Doppler-shifted H-alpha lines emitted from the neutral beam. Initial studies on the Doublet III tokamak showed that appropriate analysis will evidently have to include spitting of these lines due to the motional Stark effect and the Zeeman effect. Author

N88-24520# Nagoya Univ. (Japan). Inst. of Plasma Physics.
FORBIDDEN TRANSITIONS AS ION-TEMPERATURE SENSITIVE LINES Abstract Only
Kuninori Sato *In its* Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 9 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

The effect of heavy particle (proton and deuteron) collisions on the intensity of forbidden lines of highly ionized ions is described. Except for the excitation of plasma impurity ions by charge-exchange recombination with neutral hydrogen, the effects of inelastic collisions between heavy particles are not generally considered to be significant excitation processes in plasma, because of the low velocity of the impinging particle compared to electrons. However, that heavy particle excitation is not completely lacking is borne out by evidence of large proton-induced excitation rates between closely spaced levels in ground state configuration of highly ionized ions in a plasma heated at a high proton temperature. The intensity ratio of forbidden line to allowed line of Fe XVIII was measured during RF heating on the JIPP TII-U tokamak. The results at low electron density indicated a noticeable effect of proton collisions on the intensity of the forbidden line at the time of heating. In the PLT deuterium discharges, two line ratios (a forbidden line to an allowed line of Fe XXII, a forbidden line to a forbidden line of Fe XIX) were measured as the ion-temperature sensitive line ratios during RF heating. Measured relative intensities are compared with those estimated from calculation which include the excitation by deuteron collision between the levels of the ground configuration. The agreement between the observed and calculated ratios are discussed.
Author

N88-24521# Johns Hopkins Univ., Baltimore, Md.
TOKAMAK STUDIES OF DENSITY SENSITIVE LINE RATIOS Abstract Only
Warren Moos *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 10 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

A number of different elements were injected into the TEXT tokamak in order to study the emission spectra in the 15 to 2000 A range. A number of lines were identified for the first time. The relative brightnesses of the spectral lines were measured by instruments with photoelectric detectors which were photometrically calibrated against synchrotron radiation. Line pair ratios were measured as a function of Z along isoelectronic sequences. For Be-like ions the brightness ratio of the 2s2p (3)P2 - 2p(2) (3)P2 to the resonance 2s(2) (1)S0 - 2s2p (1)P1 line was measured for various ions from C III to Ne VII (low Z) and from Cl XIV to Cr XXI (intermediate Z). A comparison with theoretical predictions showed that for low Z, agreement was obtained with calculations using the R-matrix technique. For intermediate Z, when the R-matrix and distorted wave calculations appear to converge, the ratio of the experimental to distorted wave theoretical values was 1.01 + or - 0.19 indicating good agreement. Author

N88-24522# Kyoto Univ. (Japan). Dept. of Engineering Science.
DENSITY DIAGNOSTICS BY HYDROGEN LINE INTENSITY RATIOS: EXCITATION CROSS SECTION BETWEEN EXCITED STATES Abstract Only
Takashi Fujimoto *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 11 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

Neutral hydrogen in a tokamak plasma is a typical example of an ionizing-phase plasma. In the density regions lower than Griem's critical density, the excited state is in the corona phase, and its population is proportional to n(e). In the higher density regions it enters into the saturation phase, and its population is controlled by the multistep, ladder-like excitation mechanism, deviating from the linear dependence. For the upper levels of practical interest, n = 2 through 6, the critical density lies between 10(10) and 10(14) cm(-3), which is relevant to the tokamak plasma. Thus, there is a possibility of applying the Lyman or Balmer line intensities to the determination of the electron density as well as to the ionization flow and the hydrogen atom density. For that purpose, a reliable set of excitation cross sections is needed. The present state of knowledge is reviewed and it is shown that some essential cross section data are lacking. Author

N88-24523# Kyoto Univ. (Japan). Plasma Physics Lab.
SPECTROSCOPIC STUDY OF HELIOTRON E PLASMAS: STARK PROFILE, CXR, POLOIDAL ROTATION AND CARBON COATING Abstract Only
K. Kondo, H. Zushi, S. Nishimura, K. Okazaki, T. Oda (Hiroshima Univ., Japan), H. Kaneko, H. Okada, S. Besshou, T. Mizuuchi, and Y. Takeiri et al. *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 12 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

Four areas of study are discussed. (1) Pellet injection is considered one of the most promising methods for obtaining high density plasmas, and it is important to analyze the ablation mechanism. The H-alpha emission was used to estimate the ablation rate. The spectral profiles of H-alpha and H-beta show Stark broadening when a high density electron cloud surrounds the injected pellet. An analysis of various plasma parameters is presented. (2) Charge exchange recombination (CXR) emissions have been widely used to estimate ion temperature in large machines with high-power neutral beam injection. The neutral beam is used as a diagnostic beam, and ion temperatures are obtained by observing C VI (3435 A), He II (4686 A), and H-alpha (D-alpha) emissions. (3) The Doppler shifts of line emissions (C V, O V) provide the macroscopic motion of plasmas. Preliminary measurements showed that the poloidal rotation in the neutral beam heated plasma was in the direction of the E x B drift derived by negative potential. (4) Glow discharge with CH4 + H2 gas mixtures for carbon coating on vacuum vessel walls was performed. The identification of the spectrum and the estimation of the rotational temperature of CH and H2 molecules are presented.
Author

N88-24524# Kyoto Univ. (Japan). Plasma Physics Lab.
OBSERVATION OF INJECTED SILICON IN HELIOTRON E Abstract Only
H. Kaneko et al. *In* Nagoya Univ., Summary Report on the

Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 13 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

Silicon was injected into the Heliotron E plasmas in order to examine the impurity transport. The observed brightness of vacuum ultraviolet VUV (Si XI = 30.33 nm and Si XII = 49.94 nm) and soft X-ray SX (Si XIII, Si XIV and continuum) were compared with numerical code predictions, which describe the transport, the ionization balance and the radiation. In the numerical code, the diffusion coefficient D and the inward flow velocity V are used in a usual 1-D transport equation in a cylindrical geometry. For the rate coefficients, the processes of electron impact ionization and radiative and dielectronic recombination are taken into account. In the stationary plasmas with continuous gas puffing, the transport equation was satisfactorily used. But discrepancy was clearly observed in a low-density electron cyclotron heated plasma of about 1 x 10(13)/cm(3). The radially resolved SX data were used to determine the gross transport coefficients D and V. In order to explain the difference between the observations and the code predictions, two processes must be included in the description: the CX recombination due to neutral hydrogen atoms and the inner shell excitations. Although the quantitative measurement of the neutral density at the plasma center has not yet been satisfactory, the contribution from the CX recombination is estimated to be too great to be neglected in the ionization balance of the impurities. The inner shell excitations and radiations can usually be neglected in the calculation of radiation losses under ionization equilibrium, but substantial radiations are expected from rapidly ionizing impurities. Author

N88-24525# Oak Ridge National Lab., Tenn. Fusion Energy Div.
SPECTRAL DIAGNOSTICS FOR TEMPERATURE AND DENSITY MEASUREMENTS ON ATF Abstract Only
R. Isler *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 14 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

Optical spectroscopy is frequently used for measuring the temperatures and densities of both electrons and ions in many types of plasmas. But, in present day toroidal fusion devices, i.e., tokamaks and stellarator-like configurations, only the ion temperatures T(i) are regularly obtained by spectroscopic methods. The techniques to be used for evaluating T(i) from Doppler broadened lines in the Advanced Toroidal Facility (ATF) are described. Transitions in the range from 1100 A to 3000 A will be used most extensively. These include the 2(3)P to 2(3)S lines of helium-like carbon, oxygen, nitrogen, and neon as well as the lines of hydrogen-like ions which are produced by charge-exchange excitation from the neutral-particle heating beams. The properties of electrons in fusion devices are ordinarily obtained by techniques other than passive optical spectroscopy. Nevertheless, various possibilities exist for assessing electron temperature T(e) and electron density n(e) from plasma radiation, and the methods which could be employed at ATF are discussed. Some of these exploit intensity ratios of transitions that are widely separated in wavelength, thereby requiring accurate relative calibrations of spectrometers. The use of charge-exchange excitation (CXE) for obtaining such calibrations from about 12 A to 1200 A are discussed; possibilities for extending these calibrations into the visible region are also addressed. Author

N88-24526# Hiroshima Univ. (Japan). Dept. of Applied Physics.
CASCADE FLUORESCENCES FROM LASER-EXCITED LITHIUM ATOM FOR PLASMA DIAGNOSTICS Abstract Only
Ken Takiyama *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 15 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

The local electric field and electron density in a plasma was measured by observing the cascade fluorescence from laser-excited Li atoms. A thermal Li beam was injected into the static electric field applied between a pair of disc electrodes installed in a vacuum vessel. The Li atom is excited from the ground level 2(2)S to the upper level 4(2)D via the middle level 2(2)P by using two dye lasers (RLE: real level excitation). Then the forbidden transition down to the level 3(2)D takes place due to Stark mixing. This results in a visible cascade fluorescence via the level 3(2)D to 2(2)P, whose intensity is a function of the electric field strength. It was possible to measure an electric field as low as 1 kV/cm by observing the fluorescence. When the second laser is tuned to the virtual level with the same energy as that of the 4(2)F (VLE: virtual level excitation) the same cascade fluorescence appears again, with an intensity about 70 times that of RLE. The reason for this is that the fluorescence intensity at the VLE is linear to the laser power for a weak field while the fluorescence at the RLE is easily saturated. Thus, a much weaker electric field of 0.2 kV/cm was detected. In order to explain the observed intensity of the cascade fluorescence, rate equations containing various relevant radiative processes were solved numerically. Further, this calculation also revealed the effect of the collisional transfer due to electron impact in plasmas on the fluorescence. The method (VLE) was applied to the measurement of the space distribution of both the electric field for RF plugging and electron density in the line cusp of the RFC-XX-M device. It was found that the electric field was enhanced in the sheet plasma. Author

N88-24527# Nagoya Univ. (Japan). Inst. of Plasma Physics.
SPECTROSCOPIC DATA RELEVANT TO ALPHA PARTICLE DIAGNOSTICS Abstract Only
M. Sasao *In its* Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 16 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

In order to measure fast alpha particles confined in a magnetic field, it is necessary to use an active method that involves various interactions with the particles. One- and two-electron transfer reactions are thought to be the most promising interactions: (1) He++ + Aq+ yields He+*(n,l) + A(q+1)+ or He++ + Aq+ yields He+(g.s.) + h nu + A(q+1)+; and (2) He++ + Aq+ yields He(0) + A(q+2)+. Here, Aq+ represents a probing atom injected as a beam or a pellet. In the diagnostic scheme using the first process (1), decaying photons emitted from He+*(n,l) ions are measured, and the alpha particle velocity distribution is obtained from the Doppler broadening of the spectral lines. Comments are also given on the cross sections for the first reaction into various (n,l) states, the bremsstrahlung background levels in the region of the spectral lines and the effect of the collision processes. Author

N88-24528# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Plasmaphysik.
FLUX DENSITY MEASUREMENTS OF NEUTRAL IRON IN TEXTOR WITH LASER INDUCED FLUORESCENCE Abstract Only
B. Schweer *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 17 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

In a tokamak erosion of the first wall material can lead to high impurity concentration in the core plasma. Large ratios of the flux densities between limiter and wall were observed in TEXTOR, but for the determination of the total impurity fluxes the erosion mechanism has to be known. The flux density of Fe I in TEXTOR at different radial positions was determined from the measurement of the particle density and velocity distribution using laser induced fluorescence. The method is described with respect to the absolute calibration of the iron density and the spectral resolution of the Doppler broadened resonance line. Author

N88-24529# Nagoya Univ. (Japan). Inst. of Plasma Physics.
MEASUREMENTS OF Z(SUB eff) PROFILE WITH A VISIBLE BREMSSTRAHLUNG CONTINUUM DETECTOR ARRAY Abstract Only
Katsumi Ida *In its* Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 18 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

A visible bremsstrahlung continuum detector array system was installed in the PBX and JIPP T-IIU tokamaks to provide 16- or 8-channel midplane tangential views of the plasmas. The wavelength measured through an interference filter is near 5230 A in both tokamaks with a passband of 6 A (PBX) and 20 A (JIPP T-IIU). The value of the effective plasma charge (Z sub eff) measured with bremsstrahlung radiation is consistent with that derived from Spiter resistivity. The effective impurity density n(e) (Z sub eff -1) in ohmic heated plasma is roughly proportional to 1/n(e) in both tokamaks, which indicates higher influx of impurities in lower density plasma operation. In the neutral beam injection (NBI) or ion cyclotron resonance frequency (ICRF) heated plasmas, Z sub eff rises at the onset of the NBI or ICRF pulse, and the Z sub eff value during the auxiliary heating increases as input power is increased. Impurity accumulation was observed typically in PBX H-mode discharges, however the accumulation is suppressed by moderate gas puff, while low gas puff operation results in impurity accumulation even in L-mode. Time evolution of the Z sub eff profile is quite helpful in studying global impurity transport, since it is usually difficult to measure the impurity density profile for each charge state which is extremely sensitive to electron temperature. Coupled with the measurements of oxygen and metallic impurity radial profile, time evolution of the Z sub eff profile in the presence of sawtooth oscillations yields a diffusion coefficient of D = 1 x 10(3) cm(2)/s for all species and an inward convective speed of upsilon = 2.2 x 10(2) (r/a) cm/s for oxygen and carbon and upsilon = 1.1 x 10(3) (r/a) cm/s for metals in PBX H-mode plasma. Author

N88-24530# Tsukuba Univ. (Japan). Plasma Research Center.
HOT ELECTRON DIAGNOSTICS USING X-RAY IMAGING ON GAMMA10 Abstract Only
N. Yamaguchi, T. Cho, T. Kondoh, M. Hirata, and S. Miyoshi et al. *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 19 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

In a tandem mirror the electrostatic potential at the end mirror cell plays a key role in plugging intrinsic ion loss in a single mirror. In the GAMMA10 axisymmetrized tandem mirror with thermal barrier, hot electrons are produced in both end mirrors through electron cyclotron resonance heating (ECRH). The electrostatic potential formed at the ECR is for end plugging, and the potential at the second harmonic resonance is for the thermal barrier, allowing selective heating of plug electrons. One critical issue of GAMMA10 is to confirm experimentally that hot electrons are actually produced in a radial distribution and peaked or abundantly filled on the magnetic axis. Bremsstrahlung X-rays are directly related to hot electrons, therefore the distribution of hot electrons can be deduced from X-ray imaging diagnostics. The temperature of hot electrons is measured to be about 50 keV. Taking into account the energy range of X-rays emitted from hot electrons, microchannel plates (MCP's) are used as position sensitive X-ray detectors. Two types of X-ray imaging systems are used. One is an X-ray pinhole camera and the other is a multichord detection system. The former is suitable for two-dimensional imaging with medium time resolution, the later is for fast time response imaging. From X-ray intensity distribution measurements, it has been confirmed that hot electrons distribute in a shape where the peak exists on the magnetic axis. The ratio of X-ray intensities through different filters is also applied to determine the spatial profile of hot electron temperature. The detection efficiency of MCP's has been measured by using radiations from a storage ring and an X-ray tube. Author

N88-24531# Kyoto Univ. (Japan). Dept. of Engineering Science.
POLARIZATION SPECTROSCOPY: PROSPECT AND DATA NEEDS Abstract Only
Takashi Fujimoto *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 20 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

When the excitation of atoms and ions is anisotropic, alignment is produced in the excited level and the emitted radiation has a spatially anisotropic intensity distribution and is polarized. Thus, these radiation characteristics are closely related to the anisotropic or non-thermal characteristics of the plasma. Deviation from the Maxwellian distribution of electron velocities is one case in point. The produced alignment may also be destroyed by an isotropic collisional or radiative process. A general formalism for the alignment collisional-radiative model is presented in which alignment production by electron collisions and by charge transfer and disalignment by electron collisions are taken into account. The details of these elementary processes for the alignment production and its relaxation are discussed. Recent observations of disalignment by electron collisions are reported. It has been found that the disalignment coefficient is closely related to the Stark broadening; an explanation is given. Author

N88-24532# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
DISTORTED-WAVE-METHOD CALCULATION OF ELECTRON-IMPACT EXCITATION OF ATOMIC IONS Abstract Only
Yukikazu Itikawa *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 21 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

A widely applicable method for calculating the cross sections for the electron-impact excitation of ions in plasmas is described. The method is a variation of the distorted-wave approximation and has three unique features: (1) the same distortion potential is used for both the initial and final states; (2) electron exchange is considered only between the interacting two electrons; and (3) use is made of very accurate (CI-type) target wavefunctions. The method has been successfully applied to calculations for He- and Be-like ions, C-like ions, and innershell excitation of Li-like ions. The method is being extended to the calculation of differential cross sections (DCS). Author

N88-24533# Osaka City Univ. (Japan). Research Inst. for Atomic Energy.
INTENSITY CALIBRATION OF A VUV SYSTEM BY BRANCHING LINE PAIRS Abstract Only
Mikio Mimura, Kuninori Sato, Ryuichi Akiyama, and Masamoto Otsuka (Nagoya Univ., Japan) *In* Nagoya Univ., Summary Report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 22 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

Nine vacuum ultraviolet (VUV) line pairs of carbon, oxygen, and iron were selected to perform in situ calibration of a VUV monochromator installed on the JIPP T-IIU Tokamak. Relative intensity calibration in the wavelength region from 75 A to 1230 A was made by measuring the intensity ratios of these line pairs and by arranging them by a simple proportional allotment method. Author

N88-24534# Ruhr Univ., Bochum (West Germany).
AVAILABILITY AND QUALITY OF SPECTROSCOPIC DATA AND STANDARDS FOR TOKAMAK STUDIES Abstract Only
W. L. Wiese *In* Nagoya Univ., Summary Report on the Japan-US

Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements Mar. 1988 p 23 (For primary document see N88-24512 17-75)
Avail: NTIS HC A04/MF A01

Spectroscopic data for moderately and highly ionized species of magnetic fusion interest are reviewed, mainly with respect to their availability and quality. Line identifications, wavelengths, energy levels and oscillator strengths for light elements and the transition metals are discussed, and a few representative examples are given to indicate the progress that has been achieved. New spectroscopic data tabulations are also listed and reviewed, and an overview on the availability of spectral radiation standards is given, especially for the ultraviolet. Author

N88-24269# Wisconsin Univ., Madison. Fusion Technology Inst.
MAGNET SHIELDING ANALYSIS FOR SOAR: A SPACE FUSION REACTOR
Laila A. El-Guebaly *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 61-63 Sponsored by the Grainger Foundation and the Department of the Airforce, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24336# Avco-Everett Research Lab., Mass. Military Power Programs.
NUCLEAR REACTOR MAGNETOHYDRODYNAMIC POWER GENERATOR FOR DIRECTED ENERGY WEAPONS
Daniel W. Swallom *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 351-354 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24337# California State Univ., Long Beach. Innovative Nuclear Space Power Inst.
FUNDAMENTAL ANALYSIS OF SPACE NUCLEAR-MHD GENERATOR FOR GIGAWATT-LEVEL POWER
Julius Goodman, Isaac Maya, and J. Richard Williams *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 355-359 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24338# Ben Gurion Univ. of the Negev, Beersheva (Israel). Center for MHD Studies.
LIQUID-METAL MHD POWER CONVERSION FOR SPACE ELECTRIC SYSTEMS
L. Blumenau, H. Branover, A. El-Boher, E. Spero, S. Sukoriansky, and E. Greenspan (Israel Atomic Energy Commission, Beersheba.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 361-366 Sponsored by SOLMECS Corp. and Israel Ministry of Industry and Trade (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24339# Institut de Mecanique de Grenoble (France).
STUDIES FOR THE DEFINITION OF A FARADAY CONVERTER FOR SPACE NUCLEAR SYSTEMS
A. Alemany, R. Laborde, Ph. Marty, J. P. Thibault, and F. Werkoff (Commissariat a l'Energie Atomique, Grenoble, France) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 367-369 Sponsored by CNRS, France and CNES, France (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24348# Ebasco Services, Inc., New York.
A LIQUID METAL MHD CONCEPT FOR MULTIMEGAWATT SPACE POWER APPLICATION
J. R. Bilton, R. L. Hensler, V. A. Walker, B. L. Rushton, R. G. Ambrosek, B. G. Schnitzler, F. J. Wheeler, V. W. Storhok, J. A. Lake, and R. P. Wadkins (Idaho National Engineering Lab., Idaho Falls.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 411-414 (For primary document see N88-24254 17-73)
(Contract DE-AC07-76ID-01570)
Avail: NTIS HC A22/MF A01

N88-24364# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
ADVANCED LMMHD SPACE POWER GENERATION CONCEPT
Vincent Ho, Albert Wong, Kilyoo Kim, and Vijay Dhir *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 481-484 Sponsored by Defense Nuclear Agency, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24366# Wisconsin Univ., Madison. Fusion Technology Inst.
SOAR: SPACE ORBITING ADVANCED FUSION POWER REACTOR
J. F. Santarius, G. L. Kulcinski, H. Attaya, M. L. Corradini, L. A. El-Guebaly, G. A. Emmert, C. W. Maynard, M. E. Sawan, I. N. Sviatoslavsky, and W. F. Vogelsang et al. *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 489-492 Sponsored by the Grainger Foundation and Department of the Air Force, Washington, D.C. (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24471# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
A NUCLEAR POWERED SPACE BASED MULTIMEGAWATT MHD DISC POWER SYSTEM
Robert R. Holman, Joseph R. Lance, Lawrence E. VanBibber, and Jean F. Louis (Massachusetts Inst. of Tech., Cambridge.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 469-472 (For primary document see N88-24374 17-73)
(Contract DE-AC22-87PC-79665)
Avail: NTIS HC A99/MF A01

N88-24472# Florida Univ., Gainesville.
BURST POWER GAS CORE REACTOR WITH MHD POWER GENERATION
Edward T. Dugan, William E. Lear, Jr., and Gerard E. Welch *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 473-477 Sponsored in part by Frederick A. Hauck Fund, Florida Univ., Gainesville, AFWAL, Wright-Patterson AFB, Ohio and NSF Supercomputer Center, San Diego, Calif. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

N88-24473# Space Power, Inc., San Jose, Calif.
GIGAWATT, CLOSED CYCLE, VAPOR CORE-MHD SPACE POWER SYSTEM CONCEPTUAL DESIGN STUDY
Joseph R. Wetch, Hyop S. Rhee, J. Kent Koester, Julius Goodman, and Issac Maya (California State Univ., Long Beach.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 479-483 (For primary document see N88-24374 17-73)
(Contract DNA001-85-C-0320)
Avail: NTIS HC A99/MF A01

N88-24474# Wisconsin Univ., Madison. Fusion Technology Inst.
CRITICAL ISSUES FOR SOAR: THE SPACE ORBITING ADVANCED FUSION POWER REACTOR
J. F. Santarius, G. L. Kulcinski, L. A. El-Guebaly, G. A. Emmert, Z. Musicki, M. E. Sawan, I. N. Sviatoslavsky, W. F. Vogelsang, P. L. Walstrom, and L. J. Wittenberg *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 485-488 Sponsored by Department of the

Air Force, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N88-24535# Argonne National Lab., Ill.
SUPERCONDUCTING THIN FILM VERTEX DETECTOR FOR SSC (SUPERCONDUCTING SUPER COLLIDER) APPLICATIONS
R. G. Wagner and K. E. Gray 1987 10 p Presented at the International Workshop on Superconductive Particle Detectors, Torino, Italy, 26-30 Oct. 1987
(Contract W-31-109-eng-38)
(DE88-005951; ANL-HEP-CP-87-124; CONF-8710218-3) Avail: NTIS HC A02/MF A01

A possibly very-radiation-hard detector based on superconducting thin film strips is described. The interaction of the thin film detector with charged particles is discussed, and the feasibility of extending previous work on alpha-particle detection to the more stringent requirements for minimum ionizing particles is considered. A novel approach to the readout is briefly outlined which utilizes the slow phase velocity of electromagnetic waves possible in superconducting waveguides. DOE

N88-24536# Academy of Sciences of the Ukrainian SSR, Kiev.
INTERACTION OF SLOW NEUTRONS WITH Ge74 SINGLE CRYSTALS
V. A. Pshenichny, En Men Pak, F. M. Vorobkalo, and V. P. Vertebnyj 1986 7 p In RUSSIAN; ENGLISH summary
(DE87-703010; KIYI-86-27) Avail: NTIS (US Sales Only) HC A02/MF A01

The total cross section of a monocrystal from a germanium isotope by the time-of-flight method in the 0.17 to 10 eV range is measured. At room temperature the monocrystal possesses the capability of separating from the white reactor spectrum intensive beams of thermal neutrons. It is shown that the Ge (74) monocrystal, by its filtering properties, approaches to the Si monocrystal. The observed cross sections for the Si, Ge and Ge (74) monocrystals in the thermal region of neutron energy are indicated in the study. DOE

N88-24537# Rochester Univ., N. Y. Lab. for Laser Energetics.
MICRO-RAMAN ANALYSIS OF DIELECTRIC OPTICAL THIN FILMS Final Technical Report, 1 May 1985 - 30 Sep. 1987
Ansgar Schmid 7 Jan. 1988 24 p
(Grant AF-AFOSR-0221-85)
(AD-A191228; AFOSR-88-0160TR) Avail: NTIS HC A03/MF A01 CSCL 07B

Wide-band-gap dielectric thin films up to 6 micrometer in thickness are characterized by spontaneous and stimulated Raman-gain microscopy. Materials surveyed are Aluminum oxide, Yttrium oxide, Zirconium oxide, Hafnium oxide, and Tantalum oxide. 1-micrometer sized surface defects on Y2O3 are investigated. GRA

N88-24538# Wales Univ. Inst. of Science and Technology, Cardiff.
PREPARATION OF IMPROVED PbSnTe THERMOELECTRIC ALLOYS AND EVALUATION OF THEIR FIGURE OF MERIT Final Technical Report, 1986 - 1987
D. M. Rowe Dec. 1987 27 p
(Contract DAJA45-86-C-0032; DA Proj. 1L1-61103-BH-57)
(AD-A191346) Avail: NTIS HC A03/MF A01 CSCL 09A

Lead telluride type semiconductors are used in the fabrication of thermoelectric modules currently employed in a number of U.S. military applications. This report covers a program to produce materials based upon commercially available lead telluride type material (specifically identified as 3P) with improved figures of merit and hence greater thermoelectric conversion efficiency. One way of improving the figure of merit is by reducing the lattice thermal conductivity of the material in order to increase phonon-grain boundary scattering. A realistic model has been developed for PbSnTe and used to investigate the dependence of the lattice thermal conductivity on grain size and level doping. Thermal diffusivity measurements on small gain size compacted 3P material indicate that the reduction in lattice thermal conductivity is more than double that predicted by the theoretical model and is comparable to the reduction reported for silicon germanium alloys. The measured electric power factor values do not appear to decrease with a reduction in grain or size. GRA

N88-24539*# Rockwell International Science Center, Thousand Oaks, Calif.
DEVELOPMENT OF 20 GHz MONOLITHIC TRANSMIT MODULES Final Report, 30 Nov. 1981 - 30 Nov. 1987
J. A. Higgins May 1988 101 p
(Contract NAS3-23247)
(NASA-CR-182134; NAS 1.26:182134; SC5492.FR) Avail: NTIS HC A06/MF A01 CSCL 20L

The history of the development of a transmit module for the band 17.7 to 20.2 GHz is presented. The module was to monolithically combine, on one chip, five bits of phase shift, a buffer amplifier and a power amplifier to produce 200 mW to the antenna element. The approach taken was MESFET ion implanted device technology. A common pinch-off voltage was decided upon for each application. The beginning of the total integration phases revealed hitherto unencountered hazards of large microwave circuit integration which were successfully overcome. Yield and customer considerations finally led to two separate chips, one containing the power amplifiers and the other containing the complete five bit phase shifter. Author

N88-24540 New South Wales Univ., Sydney (Australia). School of Physics.
THE STRUCTURAL ANALYSIS OF SOME CRYSTALLINE AND SEMI-CRYSTALLINE SUBSTANCES USING X-RAY AND NEUTRON DIFFRACTION M.S. Thesis Abstract Only
Stephen James Foster Dec. 1986 153 p
Avail: Issuing Activity

The crystal and molecular structures of three compounds were investigated using three dimensional single crystal X-ray diffraction techniques. One dimensional neutron diffraction experiments on artificially reconstituted biological membranes are described. Author

N88-24541*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE GAMMA 1 AND GAMMA 3 BANDS OF (16)O3: LINE POSITIONS AND INTENSITIES
J.-M. Flaud, C. Camy-Peyret, V. Malathy Devi (College of William and Mary, Williamsburg, Va.), C. P. Rinsland, and M. A. H. Smith [1988] 23 p
(NASA-TM-101162; NAS 1.15:101162) Avail: NTIS HC A03/MF A01 CSCL 20L

Using 0.005/cm-resolution Fourier transform spectra of samples of ozone, the gamma 1 and gamma 3 bands of (16)O3 have been reanalyzed to obtain accurate line positions and an extended set of upper state rotational levels (J up to 69, K sub a up to 20). Combined with the available microwave data, these upper state rotational levels were satisfactorily fitted using a Hamiltonian which takes explicitly into account the strong Coriolis interaction affecting the rotational levels of these two interacting states. In addition, 350 relative line intensities were measured from which the rotational expansions of the transition moment operators for the gamma 1 and gamma 3 states have been deduced. Finally, a complete listing of line positions, intensities, and lower state energies of the gamma 1 and gamma 3 bands of (16)O3 has been generated. Author

N88-24542*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LINE POSITIONS AND INTENSITIES FOR THE GAMMA 1 + GAMMA 2 AND GAMMA 2 + GAMMA 3 BANDS OF (16)O3
V. Malathy Devi, J.-M. Flaud, C. CanyPeyret (Paris VI Univ., France), C. P. Rinsland, and M. A. H. Smith [1988] 22 p Submitted for publication
(Contract NCC1-80)
(NASA-TM-101161; NAS 1.15:101161) Avail: NTIS HC A03/MF A01 CSCL 20L

Using 0.005 cm-resolution Fourier transform spectra of (16)O3, generated by electric discharge from a greater than 99.98 percent pure sample of (16)O3, an extensive analysis of the gamma 1 + gamma 2 and the gamma 2 + gamma 3 bands in the 5.7 micron region was performed. The rotational energy levels of the upper (110) and (011) vibrational states of (16)O3 were reproduced within their experimental uncertainties using a Hamiltonian which takes explicitly into account the Coriolis-type interaction occurring between the rotational energy levels of both states. Improved vibrational energies and rotational and coupling constants were also derived for the (110) and (011) states. Precise transition moment constants for these two bands were deduced from analysis of 220 measured line intensities. Finally, a complete list of line positions, intensities, and lower state energies for both bands has been generated. Author

N88-24543* National Aeronautics and Space Administration. Pasadena Office, Calif.
METHOD OF PRODUCING HIGH T(SUBc) SUPERCONDUCTING NBN FILMS Patent
Sarita Thakoor, inventor (to NASA), James L. Lamb, inventor (to NASA), Anilkumar P. Thakoor, inventor (to NASA), and Satish K. Khanna, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 23 Feb. 1988 13 p Filed 12 Aug. 1985 Supersedes N86-21401 (24 - 11, p 1878)
(NASA-Case-NPO-16681-1-CU; US-Patent-4,726,890; US-Patent-Appl-SN-764812; US-Patent-Class-204-192.24; US-Patent-Class-204-192.15) Avail: US Patent and Trademark Office CSCL 20L

Thin films of niobium nitride with high superconducting temperature (T sub c) of 15.7 K are deposited on substrates held at room temperature (approx 90 C) by heat sink throughout the sputtering process. Films deposited at P sub Ar 12.9 + or - 0.2 mTorr exhibit higher T sub c with increasing P sub N2,I with the highest T sub c achieved at P sub n2,I= 3.7 + or - 0.2 mTorr and total sputtering pressure P sub tot = 16.6 + or - 0.4. Further increase of N2 injection starts decreasing T sub c.
Official Gazette of the U.S. Patent and Trademark Office

N88-24544* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METHOD AND APPARATUS FOR GROWING CRYSTALS Patent
Robert J. Naumann, Sandor L. Lehoczky, and Donald O. Frazier 19 Apr. 1988 11 p Filed 31 Oct. 1986 Supersedes N87-19116 (25 - 11, p 1527)
(NASA-Case-MFS-28137-1; US-Patent-4,738,831; US-Patent-Appl-SN-925189; US-Patent-Class-422-246; US-Patent-Class-156-607; US-Patent-Class-156-621; US-Patent-Class-156-624; US-Patent-Class-156-DIG.70; US-Patent-Class-156-DIG.72; US-Patent-Class-156-DIG.82) Avail: US Patent and Trademark Office CSCL 20L

A method and apparatus for bulk growth of defect-free compound crystals is described. Crystal growth is conducted in this invention in an apparatus having an enclosure with a spherical interior provided with an adjustable heat source. A seed crystal is positioned within this interior and is connected to one end of a rod of heat conductive material which extends through the enclosure. The rod is independently heated, and a heat absorber is connected to an opposite end of the rod. Crystalline material is placed in the interior of the sphere and in engagement with the seed crystal and pressure is applied to it. Encapsulant material having a slightly lower melting point than the crystalline material is disposed between the latter and the spherical container wall. A crystal structure is grown by heating the crystalline material up to a set temperature while controlling heat dissipation through the rod by the application of heat to the rod. Heat application is reduced, allowing heat to escape via the seed crystal and the rod of the material, causing the crystalline material to be deposited as a single crystal on the seed crystal. The novelty of the invention is believed to reside in the use of a spherical container with with a heat removal rod at one pole of the sphere, the rod providing control of the shape of the crystal-liquid interface during solidification. These feature permit growth of relatively large, defect-free crystals of compound materials.
Official Gazette of the U.S. Patent and Trademark Office

N88-24545* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LIQUID ENCAPSULATED FLOAT ZONE PROCESS AND APPARATUS Patent
Robert J. Naumann, inventor (to NASA), Donald O. Frazier, inventor (to NASA), Sandor L. Lehoczky, inventor (to NASA), Marcus Vlasse, inventor (to NASA), and Barbara R. Facemire, inventor (to NASA) 26 Apr. 1988 7 p Filed 29 Oct. 1986 Supersedes N87-15004 (25 - 06, p 826)
(NASA-Case-MFS-28144-1; US-Patent-4,740,264; US-Patent-Appl-SN-924399; US-Patent-Class-156-620.76; US-Patent-Class-156-DIG.70; US-Patent-Class-156-DIG.72; US-Patent-Class-156-DIG.82; US-Patent-Class-156-DIG.84; US-Patent-Class-156-DIG.89; US-Patent-Class-156-DIG.92) Avail: US Patent and Trademark Office CSCL 20L

The process and apparatus for growing crystals using float zone techniques are described. A rod of crystalline materials is disposed in a cylindrical container, leaving a space between the rod and container walls. This space is filled with an encapsulant, selected to have a slightly lower melting point than the crystalline material. The rod is secured to a container end cap at one end and to a shaft at its other end. A piston slides over the rod and provides pressure to prevent loss of volatile components upon melting of the rod. Prior to melting the rod the container is first heated to melt the encapsulant, with any off-gas from this step being vented to a cavity behind the piston. The piston moves slightly forward owing to volume change upon melting of the encapsulant, and the vent passageway is closed. The container is then moved longitudinally through a heated zone to progressively melt sections of the rod as in conventional float zone processes. The float zone technique may be used in the microgravity environment of space.
Official Gazette of the U.S. Patent and Trademark Office

N88-24243*# Brookhaven National Lab., Upton, N. Y.
SYSTEMATIC VARIATION OF MAGNETIC-FIELD PENETRATION DEPTH IN HIGH-T(c) SUPERCONDUCTORS STUDIED BY MUON SPIN RELAXATION
Y. J. Uemura, V. J. Emery, A. R. Moodenbaugh, M. Suenaga, D. C. Johnston, A. J. Jacobson, J. T. Lewandowski, J. H. Brewer, R. F. Kiefl, and S. R. Kreitzman (Tri-Univ. Meson Facility, Vancouver, British Columbia) et al. *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 15 p Sponsored in part by the NSERC, Canada (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grant NSF DMR-85-03223)
Avail: NTIS HC A05/MF A01 CSCL 20L

N88-24244*# Brookhaven National Lab., Upton, N. Y.
COMPARISON BETWEEN MUON SPIN ROTATION AND NEUTRON SCATTERING STUDIES ON THE 3-DIMENSIONAL MAGNETIC ORDERING OF La2CuO(4-y)
Y. J. Uemura, W. J. Kossler, J. R. Kempton, X. H. Yu, H. E. Schone, D. Opie, C. E. Stronach, J. H. Brewer, R. F. Kiefl, and S. R. Kreitzman (Tri-Univ. Meson Facility, Vancouver, British Columbia) et al. *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 10 p Presented at the Interlaken HTSC-M2S Conference, Feb. 1988 Sponsored in part by NSERC, Canada and the Ministry of Education, Culture and Science,

Japan (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grant NSF DMR-85-03223)
Avail: NTIS HC A05/MF A01 CSCL 20L

N88-24245*# Brookhaven National Lab., Upton, N. Y.
COEXISTING STATIC MAGNETIC ORDERING AND SUPERCONDUCTIVITY IN CeCu2.1Si2 FOUND BY MUON SPIN RELAXATION
Y. J. Uemura, W. J. Kossler, X. H. Yu, H. E. Schone, J. R. Kempton, C. E. Stronach, S. Barth, F. N. Gygax, B. Hitti, and A. Schenck (Eidgenoessische Technische Hochschule, Zurich, Switzerland) et al. *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 14 p Sponsored in part by Ministry of Education, Science and Culture, Japan (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grants NSF DMR-85-03223; NSF INT-84-13978)
Avail: NTIS HC A05/MF A01 CSCL 20L

N88-24246*# Brookhaven National Lab., Upton, N. Y.
STATIC MAGNETIC ORDERING OF CeCu2.1Si2 FOUND BY MUON SPIN RELAXATION
Y. J. Uemura, W. J. Kossler, X. H. Yu, H. E. Schone, J. R. Kempton, C. E. Stronach, S. Barth, F. N. Gygax, B. Hitti, and A. Schenck (Eidgenoessische Technische Hochschule, Zurich, Switzerland) et al. *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 7 p Presented at the Interlaken HTSC-M2S Meeting, Feb. 1988 Sponsored in part by Ministry of Education, Science and Culture, Japan (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grants NSF DMR-85-03223; NSF INT-84-13978)
Avail: NTIS HC A05/MF A01 CSCL 20L

N88-24247*# College of William and Mary, Williamsburg, Va.
MUON MOTION IN TITANIUM HYDRIDE
J. R. Kempton, K. G. Petzinger, W. J. Kossler, H. E. Schone, B. S. Hitti, C. E. Stronach, N. Adu, W. F. Lankford, J. J. Reilly, and E. F. W. Seymour (Warwick Univ. Coventry, England) *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 22 p (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grant NSF DMR-85-03223)
Avail: NTIS HC A05/MF A01 CSCL 20L

N88-24248*# Brookhaven National Lab., Upton, N. Y.
SEARCH FOR BOUND STATES OF THE ETA-MESON IN LIGHT NUCLEI
R. E. Chrien, S. Bart, P. Pile, R. Sutter, N. Tsoupas, H. O. Funsten, J. M. Finn, C. Lyndon, V. Punjabi, and C. F. Perdrisat (College of William and Mary, Williamsburg, Va.) et al. *In* Virginia State Univ., Materials Science with Muon Spin Rotation 29 Feb. 1988 13 p (For primary document see N88-24242 17-72)
(Contract DE-AC02-76CH-00016; Grant NSF PHY-85-09880-05)
Avail: NTIS HC A05/MF A01 CSCL 20L

N88-24316*# Hampden-Sydney Coll., Va. Dept. of Physics.
NEUTRON RADIATION TOLERANCE OF Au-ACTIVATED SILICON
W. T. Joyner *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 263-264 (For primary document see N88-24254 17-73)
(Grant NAG3-605)
Avail: NTIS HC A22/MF A01 CSCL 20L

N88-24317# Missouri Univ., Columbia. Research Reactor.
DEFECTS IN CUBIC SILICON CARBIDE ON SILICON
V. Nagesh, J. W. Farmer, R. F. Davis, and H. S. Kong (North Carolina State Univ., Raleigh.) *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 265-268 (For primary document see N88-24254 17-73)
(Grant NSF DMR-85-04719)
Avail: NTIS HC A22/MF A01

N88-24319# Missouri Univ., Columbia. Dept. of Physics and Astronomy.
POINT DEFECTS IN IRRADIATED SILICATES
V. Priest, D. L. Cowan, F. K. Ross, and D. G. Reichel *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 275-278 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24370# Missouri Univ., Rolla.
MODELING OF RADIATION DOSE DEPENDENCE OF MOSFETs
C. F. Tang, C. H. Wu, and A. Kumar *In* New Mexico Univ., Transactions of the Fourth Symposium on Space Nuclear Power Systems 1987 p 505-507 (For primary document see N88-24254 17-73)
Avail: NTIS HC A22/MF A01

N88-24462# Sandia National Labs., Albuquerque, N. Mex.
THE RESPONSE OF SELECTED SEMICONDUCTOR TECHNOLOGIES TO THE COMBINED ENVIRONMENTAL EFFECTS OF HIGH TEMPERATURE AND TOTAL DOSE GAMMA RADIATION
D. B. King, W. T. Wheelis, and S. M. Luker *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 427-430 (For primary document see N88-24374 17-73)
(Contract DE-AC04-75DP-00789)
Avail: NTIS HC A99/MF A01

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N88-24546*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RAYCHAUDHURI EQUATION IN THE SELF-CONSISTENT EINSTEIN-CARTAN THEORY WITH SPIN-DENSITY
A. J. Fennelly, Jean P. Krisch, John R. Ray (Clemson Univ., S.C.), and Larry L. Smalley [1988] 18 p Prepared in cooperation with Alabama Univ., Huntsville Submitted for publication
(NASA-TM-101145; NAS 1.15:101145) Avail: NTIS HC A03/MF A01 CSCL 20C

The physical implications of the Raychaudhuri equation for a spinning fluid in a Riemann-Cartan spacetime is developed and discussed using the self-consistent Lagrangian based formulation for the Einstein-Cartan theory. It was found that the spin-squared terms contribute to expansion (inflation) at early times and may lead to a bounce in the final collapse. The relationship between the fluid's vorticity and spin angular velocity is clarified and the effect of the interaction terms between the spin angular velocity and the spin in the Raychaudhuri equation investigated. These results should prove useful for studies of systems with an intrinsic spin angular momentum in extreme astrophysical or cosmological problems. Author

N88-24547*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INFLATION IN EINSTEIN-CARTAN THEORY WITH ENERGY-MOMENTUM TENSOR WITH SPIN
A. J. Fennelly, James C. Bradas (Army Missile Command, Redstone Arsenal, Ala.), and Larry L. Smalley [1988] 18 p
(NASA-TM-101164; NAS 1.15:101164) Avail: NTIS HC A03/MF A01 CSCL 20C

Generalized, or power-law, inflation is shown to necessarily exist for a simple, anisotropic (Bianchi Type I) cosmology in the Einstein-Cartan gravitational theory with the Ray-Smalley (RS) improved energy-momentum tensor with spin. Formal solution of

the EC field equations with the fluid equations of motion explicitly shows inflation caused by the RS spin angular kinetic energy density. Author

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N88-24548# Department of Defense, Washington, D. C.
DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR). VOLUME 3: AIR FORCE ABSTRACTS OF PHASE 1 AWARDS, 1987
Apr. 1988 219 p
Avail: NTIS HC A10/MF A01 CSCL 05A

The abstracts and contracts for the 350 Phase 1 projects funded by the Air Force from the FY 1987 Small Business Innovation Research (SBIR) Program are presented. B.G.

N88-24549 New South Wales Univ., Kensington (Australia). Dept. of Organisational Behaviour.
THE RELATIONSHIP BETWEEN GROUP PROCESS AND PERFORMANCE Abstract Only. Ph.D. Thesis
Rudolf E. Weber Dec. 1986 439 p
Avail: Issuing Activity

Videotapes showing the interaction of 67 randomly assembled triads working on Eureka and Non Eureka tasks were independently analyzed by two trained observers using an observation and scoring procedure designed for the purpose. The resulting records were sampled and a series of specific hypotheses, stipulating the effects of critical extraneous variables and the links between the variables constituting the model, are statistically tested. Results show that no positive link exists between the quality of the affective process and that of the prescribed information exchange process employed. Instead, triads discuss alternative solutions more thoroughly if the climate is defensive in nature. Neither does the employment of the prescribed information exchange process facilitate group performance. A direct positive relationship does, however, exist between the use of the prescribed affective process and performance, which appears to be due to the content of the discussion being more rational, more honest, and more group-centered when the affective climate is favorable. Author

N88-23803# Rockwell International Corp., Lakewood, Calif. Aircraft Operations.
COHERENT FUNCTIONAL DEVELOPMENT: KEY TO SUCCESSFUL FUTURE SYSTEM INTEGRATION
Bruce L. House *In* AGARD, The Design, Development and Testing of Complex Avionics Systems Dec. 1987 22 p (For primary document see N88-23767 17-06)
Copyright Avail: NTIS HC A18/MF A01

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N88-24040# European Space Agency, Paris (France).
ERS-1 DATA PRODUCTS AND SERVICES AND THEIR VALUE FOR TROPICAL COUNTRIES Abstract Only
Livio Marelli *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 341 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24065# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVOLUTION OF A FAMILY OF IMAGE PROCESSING SYSTEMS AT INPE [EVOLUCAO DA FAMILIA DE SISTEMAS DE TRATAMENTO DE IMAGENS DO INPE]
Ricardo Cartaxo ModestodeSouza, Celso Luis Mendes, Juan Carlos PintodeGarrido, and Gilberto Camara Neto *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 554-557 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24066# Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
SPECTRAL MEASUREMENTS FOR CORRECTING LANDSAT DATA FOR ATMOSPHERIC EFFECTS
A. Brizuela, M. A. Raed, G. Herren, and C. Martinez Casado *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 558-561 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24067# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STUDY OF METHODS OF POST-PROCESSING APPLIED TO A PROBLEM OF STANDARD CLASSIFICATION [ESTUDO DE METODOS DE POS-PROCESSAMENTO APLICADO A PROBLEMA DE CLASSIFICACAO DE PADROES]
Luciano Vieira Dutra and Jose Carlos Moreira *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 562-568 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24068# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A PROPOSAL OF ADAPTATION OF A KNOWLEDGE-BASED SCENE ANALYSIS MODEL TO SOME REMOTE SENSING PROBLEMS
Paulo Ouvera Simoni *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 569-575 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24080# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
AUTOMATIC REGISTRATION OF SATELLITE IMAGERY [REGISTRO AUTOMATICO DE IMAGENS DE SATELITE]
Gilberto Camara Neto *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 669-671 In

PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24081# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
VISUALIZATION OF DIGITAL TERRAIN MODELS [VISUALIZACAO DE MODELOS DIGITAIS DE TERRENO]
Guaraci Jose Erthal, Carlos Albert Felgueiras, and Joao ArgemirodeCarvalhoPaiva *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 672-674 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N88-24038# European Space Agency, Paris (France).
INTERNATIONAL COOPERATION IN REMOTE SENSING: THE ESA EXPERIENCE Abstract Only
Valerie Anne Hood *In* INPE, Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 337 (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

N88-24410*# Department of Energy, Washington, D. C.
UNITED NATIONS DELIBERATIONS OF THE USE OF NUCLEAR POWER SOURCES IN SPACE: 1978-1987
Gary L. Bennett, Joseph A. Sholtis, Jr., and Bruce C. Rashkow (State Dept., Washington, D. C.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 171-175 Sponsored by NASA, Washington, D.C. and DOD, Washington, D.C. (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01 CSCL 05D

N88-24411# State Dept., Washington, D. C.
DISCUSSIONS AND AGREEMENTS IN THE UNITED NATIONS ON IMPORTANT ISSUES ASSOCIATED WITH NUCLEAR POWER IN SPACE
Bruce C. Rashkow, Theodore A. Borek, Edward Keheley, Nathan J. Hoffman, and Bruce B. Gillies (Energy Technology Engineering Center, Canoga Park, Calif.) *In* New Mexico Univ., Transactions of the Fifth Symposium on Space Nuclear Power Systems 1988 p 177-179 (For primary document see N88-24374 17-73)
Avail: NTIS HC A99/MF A01

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N88-24074# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
LOW ALTITUDE REMOTE SENSING DATA IN THE IMPLEMENTATION OF A MATHEMATICAL MODEL FOR THE PLANNING OF URBAN EQUIPMENT NETWORKS [DADOS DE SENSORIAMENTO REMOTO A BAIXA ALTITUDE NA IMPLEMENTACAO DE UM MODELO MATEMATICO PARA O PLANEJAMENTO DE REDES DE EQUIPAMENTOS URBANOS]
Maria deLoudesNevesdeOliveiraKurkdjian, Maria Suelena SantiadoBarros, Horacio HidekiYanasse, Acioli AntoniodeOlivo, and Nandamudi Lankalapal Vijaykumar *In its* Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, Volume 1 1986 p 622-629 In PORTUGUESE; ENGLISH summary (For primary document see N88-24013 17-43)
Avail: NTIS HC A99/MF E03

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N88-24550*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
BALLOON-BORNE THREE-METER TELESCOPE FOR FAR-INFRARED AND SUBMILLIMETER ASTRONOMY Final Report, 1 Sep. 1983 - 31 Mar. 1988
Giovanni G. Fazio, William F. Hoffmann, and Doyal A. Harper (Chicago Univ., Ill.) Jun. 1988 109 p
(Grant NAGw-509)
(NASA-CR-182924; NAS 1.26:182924) Avail: NTIS HC A06/MF A01 CSCL 03A

The scientific objectives, engineering analysis and design, results of technology development, and focal-plane instrumentation for a two-meter balloon-borne telescope for far-infrared and submillimeter astronomy are presented. The unique capabilities of balloon-borne observations are discussed. A program summary emphasizes the development of the two-meter design. The relationship of the Large Deployable Reflector (LDR) is also discussed. Detailed treatment is given to scientific objectives, gondola design, the mirror development program, experiment accommodations, ground support equipment requirements, NSBF design drivers and payload support requirements, the implementation phase summary development plan, and a comparison of three-meter and two-meter gondola concepts.
J.P.B.

N88-24551*# Pennsylvania State Univ., University Park. Dept. of Astronomy.
SURVIVAL ANALYSIS, OR WHAT TO DO WITH UPPER LIMITS IN ASTRONOMICAL SURVEYS
Takashi Isobe and Eric D. Feigelson [1986] 3 p Submitted for publication

(Grant NAG8-555)
(NASA-CR-182936; NAS 1.26:182936) Avail: NTIS HC A02/MF A01 CSCL 03A

A field of applied statistics called survival analysis has been developed over several decades to deal with censored data, which occur in astronomical surveys when objects are too faint to be detected. How these methods can assist in the statistical interpretation of astronomical data are reviewed. Author

N88-24552# Bowling Green State Univ., Ohio. Physics and Astronomy.
IUE EVIDENCE ON THE NATURE OF THE INNERMOST BROAD-LINE REGION IN SEYFERT 1 GALAXIES
Roger L. Ptak and Ronald E. Stoner [1988] 3 p
Avail: NTIS HC A02/MF A01

The continuum level at 1550 A was obtained for most of the International Ultraviolet Explorer (IUE) images available for the Seyfert 1 galaxies NGC4151, NGC5548, and Fairall 9 (F9). Major features of the IUE spectra of these three objects, and especially the C IV lambda 1550 emission (whose emission profiles imply radial motion of the emitting carbon ions at velocities approaching 15,000 km/sec), appear to be consistent with the general picture of a fast, thick, radial outflow from a hot, starlike surface, and with approximately spherical symmetry. A supermassive star appears to be a good candidate for the central power source in these objects. J.P.B.

N88-24553*# National Aeronautics and Space Administration, Washington, D.C.
NASA THESAURUS: ASTRONOMY VOCABULARY
1988 112 p Presented at the International Astronomical Union Conference, Baltimore, Md., 27-31 Jul. 1988
(NASA-SP-7069; NAS 1.21:7069) Avail: NTIS HC A06 CSCL 03A

A terminology of descriptors used by the NASA Scientific and Technical information effort to index documents in the area of astronomy is presented. The terms are listed in hierarchical format derived from the 1988 edition of the NASA Thesaurus Volume 1 -- Hierarchical Listing. Over 1600 terms are included. In addition to astronomy, space sciences covered include astrophysics, cosmology, lunar flight and exploration, meteors and meteorites, celestial mechanics, planetary flight and exploration, and planetary science. Author

N88-24554# European Space Agency, Paris (France). Instrument Working Group.
THE HIGH-THROUGHPUT X-RAY SPECTROSCOPY MISSION
E6889478 MN513835
U. Briel, A. C. Brinkman, J. M. Ellwood, G. W. Fraser, P. A. J. DeKorte, J. Lemmon, D. H. Lumb, G. Manzo, A. Peacock, and E. Pfeffermann (Max-Planck-Inst. fuer Physik und Astrophysik, Garching, West Germany) et al. Nov. 1987 80 p
(ESA-SP-1092; ISSN-0379-6566; ETN-88-92556) Copyright Avail: NTIS HC A05/MF A01

Instrumentation to satisfy ESA's X-ray spectroscopy mission requirements of spatial resolution within 30 arc sec HEW; effective area: 10,000 sq cm at 2 keV; 5000 sq cm at 8 keV; broadband 0.1 to 10 keV spectroscopy with a resolving power of between 5 and 60; medium-resolution spectroscopy between 0.1 to 3 keV with a resolving power of over 250; and high-resolution spectroscopy in selected wavebands with a resolving power of over 1000 was defined. A CCD array is the primary broadband camera for each telescope module. A reflection-grating module fitted to two telescopes provides the medium-resolution spectroscopic capability. A Bragg crystal spectrometer fitted to two telescopes provides a high-resolution spectroscopic capability. An imaging gas-scintillation camera fitted to each telescope acts as a low-background back-up camera and complements the primary CCD camera in its weaker areas. An optical monitor provides the wide-band simultaneous optical coverage of X-ray targets to a limiting magnitude of 24. The instrument also provides the role of a bore-sight tracker for the majority of X-ray targets. ESA

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

N88-24555# Fermi National Accelerator Lab., Batavia, Ill.
QUARK CORE STARS, QUARK STARS AND STRANGE STARS
F. Grassi Jan. 1988 38 p
(Contract DE-AC02-76CH-03000)
(DE88-006991; FNAL/Pub-88/19-A) Avail: NTIS HC A03/MF A01

A recent one flavor quark matter equation of state is generalized to several flavors. It is shown that quarks undergo a first order phase transition. In addition, this equation of state depends on just one parameter in the two flavor case, two parameters in the three flavor case, and these parameters are constrained by phenomenology. This equation of state is then applied to the hadron-quark transition in neutron stars and the determination of quark star stability, the investigation of strange matter stability and possible strange star existence. DOE

N88-24556# Geneva Observatory (Switzerland).
STOCHASTICITY IN ELLIPTICAL GALAXIES
Stephane Udry and Daniel Pfenniger 1987 21 p Submitted for publication Sponsored by the Swiss National Science Foundation for Scientific Research and the Institute for Advanced Study, Princeton, N.J.
(Ser-C-Prepubl-Fasc-20; ETN-88-92501) Avail: NTIS HC A03/MF A01

Stochasticity is quantitatively estimated in a series of 24 triaxial models of elliptical galaxies by means of the Liapunov exponents. The mass distribution used is the triaxial version of the Rood profile for which a computable procedure is set up in order to obtain the gravitational force. Three perturbing potentials are superposed to the basic one: a Plummer potential corresponding to a central mass concentration and two multipolar perturbations. Different rotations and degrees of triaxiality are considered. For each model the 6 Liapunov exponents of each of 100 randomly selected orbits are computed numerically over 2 Hubble times, which provides a quantitative estimate of stochasticity. Effect of density concentration, rotation, flattening, and departures from ellipticity can thus be quantified. The most unexpected result is that all perturbations except rotation increase the degree of stochasticity. ESA

N88-24557 Massachusetts Univ., Amherst.
MOLECULAR GAS IN VIRGO CLUSTER SPIRAL GALAXIES
Ph.D. Thesis
Jeffrey Dickson Kenney [1987] 348 p
Avail: Univ. Microfilms Order No. DA8727067

The CO(J = 1 yields 0) observations with 45 deg resolution at over 200 positions along the major axes of 42 Virgo cluster spiral galaxies, were obtained using the the FCRAO 14 meter telescope. Although there is a general correlation between the CO flux of a galaxy and the optical diameter, the S sub CO/D sub opt squared ratio is found to depend on both the morphological type and the H II content. Analyses indicate that for the Sa-Sb and highest luninosity Sc Virgo galaxies, the molecular gas contents and distributions were not strongly affected by the cluster environments. There is a population of H I-rich, lower-luminosity Sc galaxies in the outer cluster with a mean S cub CO/D sub opt squared ratio of a factor of 5 less than the other Scs. Galaxies which are H I-deficient by a factor of 10 are gas-deficient by only a factor of 2 to 3, due to the survival of large quantities of molecular gas. The massive-star formation rates, as indicated by H alpha, and far-infrared emission, are also lower by factors of approximately 2 to 3 in galaxies which are H I-deficient by a factor of 10. The CO emission was detected in the center of 2 small-bulge SO-So/a Virgo galaxies which remain undetected in H I. These galaxies exhibit the expected aftereffects of a severe stripping event which occurred approximately 2 x 10 to the 9th years ago, and may be the first known example of stripped spirals in the process of turning into SO-like systems. Dissert. Abstr.

N88-24558 Yale Univ., New Haven, Conn.
DIFFERENTIAL SPECTRAL SYNTHESIS OF THE STELLAR POPULATIONS IN THE BULGES OF SPIRAL GALAXIES Ph.D. Thesis
Christopher Roger King [1987] 129 p
Avail: Univ. Microfilms Order No. DA8729090

A technique of differential spectral synthesis which compares the spectrum of a spiral bulge to a fiducial sequence based on similar spectra of elliptical galaxies is presented. This approach allows differences to be interpreted in terms of age since the elliptical sequence derives from a stellar population of uniform age in which metallicity varies. The spectrophotometry was obtained with the IIDS spectrometer on the 2.1 m teleccope at KPNO. Broadband photometry was also gathered at KPNO and is used to study the color-luminosity and color-color relations. The results of this comparative study are summarized. Dissert. Abstr.

N88-24559 California Univ., Santa Cruz.
ANALYSIS OF DUST GRAIN PROPERTIES IN TWO STAR FORMING REGIONS THROUGH COMPARISON OF THEORETICAL MODELS TO OBSERVATIONS Ph.D. Thesis
Yvonne Jean Pendleton [1987] 186 p
Avail: Univ. Microfilms Order No. DA8728189

Infrared reflection nebulae in two regions of star formation, Orion Molecular Cloud-2 and Cepheus A, were studied both observationally and theoretically. An analytical formula is derived that describes the scattered light intensity under the assumption of single scattering. The grain components, graphite, silicate, and ice, determine the scattering and absorption properties of the dust. Mie theory was used to study the behavior of a Mathis, Rumpl, and Nordsieck grain size distribution of particles, which ranged in radius from 0.005 is less than or equal to alpha is less than or equal to 0.3 and 0.05 is less than or equal to alpha is less than or equal to 0.5 micron which is called the standard and nonstandard cases, respectively. Variations of the optical depth of the nebula, the scattering angle, grain sizes, and the effect of ice mantles were investigated. The models show that it is possible to explain the continuum flux level and shape of the near infrared scattered light with illumination by a near infrared source and a grain size distribution of graphite and silicate grains. The standard case grain sizes adequately fit the observations of OMC-2. The ice feature was reported with ice mantle thicknesses that correspond to 20 percent of the available oxygen. In the case of Cep-A it was required to go to the non-standard case in order to fit the overall flux level of the reflected light. It was found that at least 40 percent of the available oxygen was needed to coat the grain sufficiently in this case. Dissert. Abstr.

N88-24560*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CONSISTENT TRANSPORT COEFFICIENTS IN ASTROPHYSICS
Juan M. Fontenla, M. Rovira, and C. FerroFontan (Buenos Aires Univ., Argentina) [1986] 75 p Submitted for publication
(NASA-TM-101154; NAS 1.15:101154) Avail: NTIS HC A04/MF A01 CSCL 03B

A consistent theory for dealing with transport phenomena in stellar atmospheres starting with the kinetic equations and introducing three cases (LTE, partial LTE, and non-LTE) was developed. The consistent hydrodynamical equations were presented for partial-LTE, the transport coefficients defined, and a method shown to calculate them. The method is based on the numerical solution of kinetic equations considering Landau, Boltzmann, and Focker-Planck collision terms. Finally a set of results for the transport coefficients derived for a partially ionized hydrogen gas with radiation was shown, considering ionization and recombination as well as elastic collisions. The results obtained imply major changes is some types of theoretical model calculations and can resolve some important current problems concerning energy and mass balance in the solar atmosphere. It is shown that energy balance in the lower solar transition region can be fully explained by means of radiation losses and conductive flux. Author

N88-24561*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
GENERATION OF FLUX TUBE WAVES IN STELLAR CONVECTION ZONES. 1: LONGITUDINAL TUBE WAVES
Z. E. Musielak, R. Rosner, and P. Ulmschneider (Heidelberg Univ., West Germany) [1987] 34 p Submitted for publication
(NASA-TM-101152; NAS 1.15:101152) Avail: NTIS HC A03/MF A01 CSCL 03B

The source functions and the energy fluxes are derived for wave generation in magnetic flux tubes embedded in an otherwise magnetic- field free, turbulent, and compressible fluid. Specific results for the generation of longitudinal tube waves are presented. Author

N88-24562*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A MODEL FOR THE X-RAY BINARY 4U1820-30
Shigeki Miyaji [1986] 17 p Submitted for publication
(NASA-TM-101143; NAS 1.15:101143) Avail: NTIS HC A03/MF A01 CSCL 03B

Analysis of X-ray bursts from 4U1820-30 implies that the mass and radius of the neutron star are 1.4 solar mass and 8 km, respectively, and that the accreted material is hydrogen rich. On the other hand, the recently discovered orbital period of 685 seconds suggests that the companion is a degenerate star consisting mostly of helium. It is shown that apparent conflict can be resolved if the mass and radius of the companion are 0.08 solar mass and 2 x 10 to the 9th cm, respectively, with a mean hydrogen concentration by weight of less than X greater than = 0.1. The possible origin of such a binary system is discussed. Author

N88-24563*# Washington Univ., Seattle. Dept. of Astronomy.
COLLIDING STELLAR WINDS IN THE ECLIPSING WOLF-RAYET BINARY V444 CYGNI
Douglas N. Brown and Steven N. Shore [1988] 21 p Submitted for publication
(Grant NAG5-537)
(NASA-CR-182937; NAS 1.26:182937) Avail: NTIS HC A03/MF A01 CSCL 03B

High resolution spectra of V444 Cygni have been obtained using the International Ultraviolet Explorer Satellite. These spectra span both eclipses and include one observation at third quadrature. Together with seven archival spectra, they provide reasonably complete phase coverage for the system. The variations in the P Cygni profiles of the He(II) and N(IV) lines, imply the existence of a low density region in the WR wind. This region occupies a relatively narrow range of orbital phase coinciding with the highest terminal velocities observed in C IV. These data are interpreted to be evidence of an interaction region separating the winds of the O-star and Wolf-Rayet star. Author

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N88-24564*# National Aeronautics and Space Administration, Washington, D.C.
REFLECTANCE SPECTROSCOPY IN PLANETARY SCIENCE: REVIEW AND STRATEGY FOR THE FUTURE
Thomas B. McCord, ed. (Hawaii Univ., Honolulu.) Jun. 1987 43 p
(NASA-SP-493; NAS 1.21:493; LC-87-28154) Avail: NTIS HC A03/MF A01 CSCL 03B

Reflectance spectroscopy is a remote sensing technique used to study the surfaces and atmospheres of solar system bodies. It provides first-order information on the presence and amounts of certain ions, molecules, and minerals on a surface or in an atmosphere. Reflectance spectroscopy has become one of the

most important investigations conducted on most current and planned NASA Solar System Exploration Program space missions. This book reviews the field of reflectance spectroscopy, including information on the scientific technique, contributions, present conditions, and future directions and needs. Author

N88-24565*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE PRECIPITATION OF ENERGETIC HEAVY IONS INTO THE UPPER ATMOSPHERE OF JUPITER
M. Horanyi, T. E. Cravens (Michigan Univ., Ann Arbor.), and J. H. Waite, Jr. Feb. 1987 74 p Submitted for publication
(NASA-TM-101155; NAS 1.15:101155) Avail: NTIS HC A04/MF A01 CSCL 03B

Evidence for auroral particle precipitation at Jupiter was provided by the ultraviolet spectrometers onboard the Voyagers 1 and 2 spacecraft and by the International Ultraviolet Explorer (IUE). Magnetospheric measurements made by instruments onboard the Voyager spacecraft show that energetic sulfur and oxygen ions are precipitating into the upper atmosphere of Jupiter. A theoretical model has been constructed describing the interaction of precipitating oxygen with the Jovian atmosphere. The auroral energy is deposited in the atmosphere by means of ionization, excitation, and dissociation and heating of the atmospheric gas. Energetic ion and electron precipitation are shown to have similar effects on the atmosphere and ionosphere of Jupiter. Author

N88-24566*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE JOVIAN AURORA: ELECTRON OR ION PRECIPITATION
J. H. Waite, Jr., J. T. Clarke, and T. E. Cravens [1986] 31 p Submitted for publication
(Grant NGR-23-005-015)
(NASA-TM-101153; NAS 1.15:101153) Avail: NTIS HC A03/MF A01 CSCL 03B

High signal-to-noise spectra of the Jovian aurora at UV wavelengths obtained using the International Ultraviolet Explorer Observatory (including the brightest Jovian aurora observed to date) set strigent upper limits for sulfur and oxygen emissions, which would be associated with the precipitation of energetic heavy ions in the upper Jovian atmosphere if they were solely responsible for Jovian auroral processes. Model calculations of heavy ion precipitation and corresponding estimates of the associated sulfur and oxygen UV emissions previously carried out suggest emission values for 1304 A OI emission that are at least 30 times larger than the upper limit values set by the IUE observations reported. On the other hand the observed (feature of SII at 1256 A of 2 kR) is quite comparable to the theoretically predicted emission intensity. Taken together these observations and calculations suggest that electron as well as ion precipitation play a role in Jovian auroral processes. In light of earlier X-ray observations and in-situ plasma observations that suggest energetic heavy ion precipitation in the Jovian auroral zone, a scenario is suggested where heavy ion auroral energy deposition is concentrated at altitudes below the homopause. Electrons with energies of 10 to 30 keV are responsible for the bulk of the observable UV and EUV emissions since they deposit their energy above the methane absorbing layer defined by the homopause. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N88-24567 Alabama Univ., Huntsville.
ON THE MAGNETIC STRUCTURE AND ENERGY BALANCE OF EUV-EMITTING PLASMA IN THE QUIET SUN Ph.D. Thesis
James F. Dowdy, Jr. [1987] 204 p
Avail: Univ. Microfilms Order No. DA8724338

The region of the solar atmosphere which emits the extreme ultraviolet (EUV) line spectrum is thought to arise in a steep temperature transition region lying between the hot corona above and the cooler chromosphere beneath. Because plasma at the hotter part of this temperature range is an efficient heat conductor, the region is thought to be powered by back heating from the corona. Conductive models have had success at calculating some of the emission characteristics of this region, but they have usually oversimplified the geometric complexity of the magnetic field which structures the solar atmosphere. The effect of the magnetic field on the ability of conductive models to provide the energy for EUV line emission was examined. After first showing that the magnetic field should be highly constricted at its cooler end, it was shown that this large magnetic constriction prevents the conductive model from predicting all of the observed EUV emission characteristics. This result holds regardless of the shape of the magnetic flux tubes which contain the plasma and regardless of the amount of conductive energy which is allowed to leave at the cooler boundary. Because back heating is widely accepted to be adequate for powering EUV-emission, the results imply that a major rethinking of the energy balance of the 100,000 to 1 million K region of the atmosphere is needed. In particular, conduction may no longer be the predominant energy loss mechanism for the corona.
Dissert. Abstr.

N88-24568 California Univ., Santa Cruz.
STABLE, HEAVY, NEUTRAL PARTICLES IN THE SUN AND IN TOPONIUM DECAY Ph.D. Thesis
Kim Ellwood Griest 1987 125 p
Avail: Univ. Microfilms Order No. DA8728160

Stable Dirac neutrinos are assumed to exist with masses of a few GeV. A formula is derived which accurately predicts the relic abundance of particles and anti-particles; this is applied to these neutrinos. The number of these particles trapped in the sun and their self-annihilation rate are found. Finally, the signal the annihilation products give in a proton decay detector is found. The rate at which particles evaporate from the sun is calculated, with the finding that if the neutrinos have masses of less than 3.0 GeV no signal can be seen. A method is suggested of finding neutralinos at a toponium resonance in e(+)e(-) collisions. The decay rate of the (3)S sub 1 state of toponium into a photon and a pair of neutralinos is calculated as a function of the supersymmetric parameters. Decay into a photon and a pair of neutrinos or s-neutrinos is also considered. A minimal supersymmetric extension of the Standard Model reveals that an observable signal exists for most parameter values if the ratio of VEVs is less than 0.3, or if a Higgs boson with mass less than the toponium mass exists. For some values of parameters, the Higgs bosons decay primarily into pairs of neutralinos.
Dissert. Abstr.

N88-24569*# New Hampshire Univ., Durham. Gamm-Ray Astronomy Group.
THE GAMMA-RAY SPECTROMETER EXPERIMENT ON THE SOLAR MAXIMUM MISSION SATELLITE Semiannual Progress Report, 16 Apr. - 15 Nov. 1987
E. L. Chupp 1 Jun. 1988 27 p
(Grant NAG5-720)
(NASA-CR-182977; NAS 1.26:182977) Avail: NTIS HC A03/MF A01 CSCL 03B

The major activities (through 15 November 1987) of the Solar Maximum Mission Gamma-Ray Spectrometer (SMM GRS) team members at the University of New Hampshire and the Naval Research Laboratory and the work of the Guest Investigators since the last Semi-Annual Report are summarized. In addition, an updated list of published papers and invited papers or papers presented at scientific meetings is provided. Author

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N88-24570# Lawrence Livermore National Lab., Calif.
SPECTRAL MODELLING OF THE SOFT GAMMA RAY REPEATER
E. P. Liang Feb. 1988 6 p Presented at the Workshop on Nuclear Spectroscopy of Astrophysical Sources, Washington, D.C., 14 Dec. 1987
(Contract W-7405-eng-48)
(DE88-007027; UCRL-98226; CONF-871245-5) Avail: NTIS HC A02/MF A01

This paper summarizes the results of numerical modelling of the spectra of the soft gamma ray repeater (SGR 1806-20). Parameters of the emission region can be extracted from the spectral fits under the simplistic assumption of isothermal and homogeneous emission layers. Limits on the luminosity distance of the source can also be derived if we make specific interpretations of the low frequency turnover in the observed spectrum. DOE

N88-24571*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A BENCHMARK FOR GALACTIC COSMIC RAY TRANSPORT CODES
John W. Wilson and Lawrence W. Townsend [1987] 15 p Submitted for publication
(NASA-TM-101157; NAS 1.15:101157) Avail: NTIS HC A03/MF A01 CSCL 03B

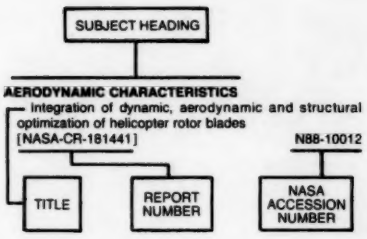
A nontrivial analytic benchmark solution for galactic cosmic ray transport is presented for use in transport code validation. Computational accuracy for a previously-developed cosmic ray transport code is established to within one percent by comparison with this exact benchmark. Hence, solution accuracy for the transport problem is mainly limited by inaccuracies in the input spectra, input interaction databases, and the use of a straight ahead/velocity-conserving approximation. Author

99 GENERAL

N88-24572*# Engineering and Economics Research, Inc., Vienna, Va.
RESEARCH AND TECHNOLOGY, 1987, GODDARD SPACE FLIGHT CENTER
Gene Guerny, ed., Karen Moe, ed., Steven Paddack, ed., Gerald Soffen, ed., Walter Sullivan, ed., and Jan Ballard, ed. (Science Systems and Applications, Inc., Greenbelt, Md.) [1987] 255 p Prepared in cooperation with Science Systems and Applications, Inc., Greenbelt, Md. Sponsored by NASA Original document contains color illustrations
Avail: NTIS HC A12/MF A01 CSCL 05D

Research at Goddard Space Flight Center during 1987 is summarized. Topics addressed include space and earth sciences, technology, flight projects and mission definition studies, and institutional technology. B.G.

Typical Subject Index Listing



The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7053).

A

ABLATION
Spectroscopic study of heliotron E plasmas: Stark profile, CXR, poloidal rotation and carbon coating N88-24523

ABRASIVES
Surface conditioning products as tools for corrosion removal and corrosion prevention N88-23856

ABSORBERS (EQUIPMENT)
Variable response load limiting device
[NASA-CASE-LAR-12801-1] N88-23982

ABSORPTION
Sources and levels of background noise in the NASA Ames 40- by 80-foot wind tunnel
[NASA-TM-100077] N88-24239

ABSTRACTS
Engine structures: A bibliography of Lewis Research Center's research for 1980-1987
[NASA-TM-100842] N88-24002
USSR Space Life Sciences Digest, Issue 17
[NASA-CR-3922(20)] N88-24155
The Shock and Vibration Digest, volume 20, no. 4 N88-24214

AC GENERATORS
Design of a superconducting alternator for space-based power generation N88-24340

ACCELERATED LIFE TESTS
Brief evaluation of the alloy 17-4-PH (Z5 CNU 17-04). Semifinished product: 205 mm dia forged roller, test reports
[DF/NH-3616/84] N88-23866

ACCELERATION (PHYSICS)
Centrifugal acceleration of ions in the polar magnetosphere
[NASA-TM-101148] N88-24120

ACCEPTABILITY
Automatically generated acceptance test: A software reliability experiment
[NASA-CR-181667] N88-23984

ACCESS CONTROL
Protection and security mechanisms in the SMITE capability computer
[RSRE-MEMO-4117] N88-24167

ACCIDENTS
Critical nuclear launch issues: A perspective from the State of Florida N88-24412
A novel plant protection strategy for transient reactors N88-24423
Evaluation of UN fuel pin failure modes and motion of fuel during severe accidents for reactors in space N88-24424
Reactor core coolability with reduced power levels N88-24425
Analysis of a nuclear orbital transfer vehicle reentry accident N88-24426

ACCUMULATORS
A dynamic model for the aft accumulator in the TE SP-100 system N88-24354

ACCURACY
Mapping from LANDSAT and SPOT satellite imagery N88-24018

ACETONE
Boundary layer flow visualization for flight testing N88-23742

ACOUSTIC EMISSION
Acoustic emission frequency discrimination
[NASA-CASE-MSC-20467-1] N88-23966

ACOUSTIC EXCITATION
Acoustically excited heated jets. 1: Internal excitation
[NASA-CR-4129-PT-1] N88-23751
Acoustically excited heated jets. 2: In search of a better understanding
[NASA-CR-4129-PT-2] N88-23752
Acoustically excited heated jets. 3: Mean flow data
[NASA-CR-4129-PT-3] N88-23753

ACOUSTIC LEVITATION
Single mode levitation and translation
[NASA-CASE-NPO-16675-1-CU] N88-24241

ACOUSTIC PROPAGATION
Study of the convergence of a finite difference scheme for acoustic propagation in the atmosphere in a parabolic approximation. Statistical calculation of the sound field in the presence of kinematic turbulence
[ONERA-RS-8/3641-PY-160-P] N88-24235
The calculation of casually constrained optima in the active control of sound
[ISVR-TR-147] N88-24237
Investigation of intensity and phase fluctuations of an acoustic wave after crossing thermal turbulence
[ETN-88-92542] N88-24238

ACOUSTICS
Control of combustion and acoustically coupled fluid dynamic instabilities N88-23843
The exact calculation of quadrupole sources for some incompressible flows
[NASA-TM-100623] N88-24240

ACRYLIC RESINS
Modification of polymers by photografting processes N88-23871

ACTIVE CONTROL
Integrated Application of Active Controls (IAAC) technology to an advanced subsonic transport project: Program review
[NASA-CR-3880] N88-23763
Vibration and control of flexible rotor supported by magnetic bearings
[NASA-TM-100888] N88-23977
The calculation of casually constrained optima in the active control of sound
[ISVR-TR-147] N88-24237

ACTUATION
Wind-tunnel investigation of actuated forebody strakes for yaw control at high angles of attack N88-23754

ACTUATORS
The LDCM actuator for vibration suppression
[NASA-CR-182898] N88-23940

ADA (PROGRAMMING LANGUAGE)
Simulation: A simulation system in Ada
[FOA-A-20043-2.7] N88-24176
Dialog design: General requirements and analysis of an Ada system --- user interface design
[FOA-C-20691-2.7] N88-24177

ADAPTIVE CONTROL
Genetic algorithms for adaptive real-time control in space systems N88-24195
Generalized predictive control of multivariable systems
[OUEL-1640/86] N88-24209
An adaptive load-following control system for a space nuclear power system N88-24307

ADDRESSING
Protection and security mechanisms in the SMITE capability computer
[RSRE-MEMO-4117] N88-24167

ADHESIVE BONDING
Polyitaconic acid macromolecule primer for adhesive bonding and corrosion control of aluminum N88-23849
Water based primers for structural adhesive bonding of aircraft N88-23862

ADVECTION
Open cell associated with warm advection N88-24010

AERIAL PHOTOGRAPHY
Latin American Symposium on Remote Sensing, 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, volume 1 N88-24013
Remote sensing techniques in the estimation of the area cultivated with beans, corn, and castor beans in the Irece County (Bahia State) N88-24045
Structure and dynamics of vegetation in the middle semi-arid tropics. Quixaba's Caatinga (PE): Terrain analysis of MSS/LANDSAT data N88-24049
Remote sensing and structural rupture: Application examples in the study of tectonics N88-24050
Analysis and interpretation of image lithostructure: An application of the multiconcept in the metamorphic belt of Sul de Santana da Boa Vista (RS) N88-24051
Tornado tracks in Southwestern Brazil, Eastern Paraguay, and Northwestern Argentina N88-24071
Interpretation of MSS/LANDSAT data for evaluation of physical distribution of mangroves in Cananeia-Iguape (SP) N88-24072
Low altitude remote sensing data in the implementation of a mathematical model for the planning of urban equipment networks N88-24074
Evaluation of the mangrove area at the Piaui River (SE) through remote sensing N88-24086
The 35 mm vertical aerial photographs for mapping stands of bracatinga in different age classes N88-24087
The breaked anticlines, cuesta and crest homoclines, ortoclinal valleys, and other forms of relief outcrops delineated with the help of remote sensing imagery N88-24089
Stereoscopic photographs, ground and aerial, of trees used in the arborization of Curitiba (PR) N88-24091
Preliminary study on the application of digital processing of TM-LANDSAT data in the mapping of apple orchards in Fraiburgo (SC) N88-24093
Characteristics of drainage determinations in aerial photographs and relief determination on different scales planialtimetric charts for three soils in the state of Sao Paulo N88-24095
Criteria for planimetric and altimetric correction of maps restituted from aerial photographs in 1:100,000 scale N88-24097

AERODYNAMIC CHARACTERISTICS
High Reynolds number tests of a Douglas DLBA 032 airfoil in the Langley 0.3-meter transonic cryogenic tunnel
[NASA-TM-87663] N88-23734
Boundary layer flow visualization for flight testing N88-23742
Natural laminar flow and airplane stability and control N88-23747
The exact calculation of quadrupole sources for some incompressible flows
[NASA-TM-100623] N88-24240

AERODYNAMIC CONFIGURATIONS
It's time to reinvent the general aviation airplane N88-23726

Full potential methods for analysis/design of complex aerospace configurations
[NASA-CR-3982] N88-23736
Preliminary aerodynamic design considerations for advanced laminar flow aircraft configurations N88-23746
Flight testing a V/STOL aircraft to identify a full-envelope aerodynamic model
[NASA-TM-100996] N88-23762
Multi-body aircraft with an all-movable center fuselage actively controlling fuselage pressure drag
[NASA-CASE-LAR-13511-1] N88-23765

AERODYNAMIC DRAG
Boundary layer measurements using hot-film sensors N88-23743

AERODYNAMIC HEATING
Nuclear-powered space debris sweeper N88-24380

AERODYNAMIC INTERFERENCE
Multi-body aircraft with an all-movable center fuselage actively controlling fuselage pressure drag
[NASA-CASE-LAR-13511-1] N88-23765

AERODYNAMIC LOADS
Certification aspects of airplanes which may operate with significant natural laminar flow N88-23749

AERODYNAMIC NOISE
Analytical modeling of the structureborne noise path on a small twin-engine aircraft
[NASA-CR-4136] N88-24233

AERODYNAMIC STALLING
Preliminary aerodynamic design considerations for advanced laminar flow aircraft configurations N88-23746

AERODYNAMICS
Joint University Program for Air Transportation Research, 1986
[NASA-CP-2502] N88-23715
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Part 4: Aerodynamic data tabulation
[NASA-CR-179469] N88-23956

AEROELASTICITY
Unsteady pressure and structural response measurements of an elastic supercritical wing
[NASA-TM-100591] N88-23756
Control law parameterization for an aeroelastic wind-tunnel model equipped with an active roll control system and comparison with experiment
[NASA-TM-100593] N88-23807

AEROSOLS
SAGE 1 and SAM 2 measurements of 1 micron aerosol extinction in the free troposphere
[NASA-CR-182945] N88-24121

AEROSPACE ENGINEERING
Technology development program for twenty-first century aerospace vehicles N88-23768
Soviet spacecraft engineering research
[FASAC-TAR-3090] N88-23823

AEROSPACE ENVIRONMENTS
EnviroNET: An interactive space-environment information resource
[NASA-TM-101137] N88-23812
Space spider crane
[NASA-CASE-LAR-13411-1-SB] N88-23828
Turbomachinery in space N88-24321

AEROSPACE MEDICINE
USSR Space Life Sciences Digest, Issue 17
[NASA-CR-3922(20)] N88-24155
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 311)
[NASA-SP-7011(311)] N88-24161

AEROSPACE PLANES
National aero-space plane: A technology development and demonstration program to build the X-30
[GAO/NSIAD-88-122] N88-23764
Review of convectively cooled structures for hypersonic flight
[NASA-TM-87740] N88-23817
Heat transfer in aerospace propulsion
[NASA-TM-100874] N88-23957

AEROTHERMODYNAMICS
Experimental measurements of heat transfer from an iced surface during artificial and natural cloud icing conditions
[AIAA-PAPER-88-1352] N88-23718
Application of integrated fluid-thermal-structural analysis methods
[NASA-TM-100625] N88-24001

AFTERBODIES
A dynamic model for the aft accumulator in the TE SP-100 system N88-24354

AGING (MATERIALS)
Investigation of the long term effects of aging on carbon epoxy composites exposed naturally to the weather under cyclic loads. (Results of sampling after 2.5 years). Test report M1-641300
[CEAT-39/M/79-C-M1-641300] N88-23834

AGING (METALLURGY)
Brief evaluation of the alloy 17-4-PH (Z5 CNU 17-04). Semifinished product: 205 mm dia forged roller, test reports
[DF/NH-3616/84] N88-23866

AGRICULTURE
Estimation of an area cultivated with wheat from LANDSAT data through a two-phase sampling method N88-24041

AIR NAVIGATION
Integrated avionics reliability N88-23723
A comparison of integrated and separate systems for flight control and navigation N88-23779

AIR POLLUTION
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125

AIR TRAFFIC CONTROL
Integrated multisensor navigation systems N88-23722
Space based radar application to air traffic control N88-24262

AIRBORNE EQUIPMENT
Preparation and execution of calibration measurements for handling of airborne SAR data (AGRISAR)
[ETN-88-92338] N88-23926
Airborne and spaceborne radar images for geologic and environmental mapping in the Amazon rain forest, Brazil N88-24021

AIRBORNE/SPACEBORNE COMPUTERS
Architecture and role of the Sensor Subsystem in future aircraft weapon systems N88-23770
Development of a generic architecture N88-23774
Test philosophy of the EH101 integrated avionic N88-23775
Modeling of functional specifications for onboard software: Experience with the Rafale avionics system N88-23777
The avionics software architecture impact on system architecture N88-23778
Design for interoperability (interchangeability) N88-23789
Development of an airborne facility for advanced avionics research N88-23801
Workshops for the design of avionics systems and the development of onboard software N88-23802
A timing evaluator for C programs generated by the model system
[AD-A191204] N88-24174

AIRCRAFT COMMUNICATION
Operation and performance of an integrated helicopter communication system N88-23787

AIRCRAFT CONSTRUCTION MATERIALS
Certification aspects of airplanes which may operate with significant natural laminar flow N88-23749

AIRCRAFT CONTROL
Joint University Program for Air Transportation Research, 1986
[NASA-CP-2502] N88-23715
Investigation of air transportation technology at Princeton University, 1986 N88-23724
Flight penetration of wind shear: Control strategies N88-23727
Natural laminar flow and airplane stability and control N88-23747
Wind-tunnel investigation of actuated forebody strakes for yaw control at high angles of attack N88-23754

AIRCRAFT DESIGN
It's time to reinvent the general aviation airplane N88-23726
Full potential methods for analysis/design of complex aerospace configurations
[NASA-CR-3982] N88-23736
Laminar Flow Aircraft Certification
[NASA-CP-2413] N88-23737
Boundary-layer stability and airfoil design N88-23738
High-flaps for natural laminar flow airfoils N88-23739
Computational wing design studies relating to natural laminar flow N88-23740
Preliminary aerodynamic design considerations for advanced laminar flow aircraft configurations N88-23746
Multi-body aircraft with an all-movable center fuselage actively controlling fuselage pressure drag
[NASA-CASE-LAR-13511-1] N88-23765
Sensitivity analysis and multidisciplinary optimization for aircraft design: Recent advances and results
[NASA-TM-100630] N88-23766
The specification and design of a future maritime reconnaissance aircraft N88-23772
A structured approach to weapon system design N88-23773

AIRCRAFT ENGINES
Engine structures: A bibliography of Lewis Research Center's research for 1980-1987
[NASA-TM-100842] N88-24002

AIRCRAFT GUIDANCE
Joint University Program for Air Transportation Research, 1986
[NASA-CP-2502] N88-23715
Investigation of air transportation technology at Princeton University, 1986 N88-23724

AIRCRAFT HAZARDS
In-flight measurement of ice growth on an airfoil using an array of ultrasonic transducers
[AIAA-PAPER-87-0178] N88-23717
Experimental measurements of heat transfer from an iced surface during artificial and natural cloud icing conditions
[AIAA-PAPER-88-1352] N88-23718

AIRCRAFT MAINTENANCE
Preventing aircraft corrosion by predictive corrosion modeling N88-23863

AIRCRAFT MANEUVERS
Full potential methods for analysis/design of complex aerospace configurations
[NASA-CR-3982] N88-23736

AIRCRAFT NOISE
Analytical modeling of the structureborne noise path on a small twin-engine aircraft
[NASA-CR-4136] N88-24233
Advisory circular: Noise certification handbook
[FAA-AC-36-4B] N88-24234

AIRCRAFT POWER SUPPLIES
Aerospace energy systems laboratory: Requirements and design approach
[NASA-TM-100423] N88-24206

AIRCRAFT SAFETY
Variable response load limiting device
[NASA-CASE-LAR-12801-1] N88-23982

AIRCRAFT STABILITY
Natural laminar flow and airplane stability and control N88-23747

AIRCRAFT STRUCTURES
Fuel containment, lightning protection and damage tolerance in large composite primary aircraft structures
[NASA-CR-3875] N88-23839
Water based primers for structural adhesive bonding of aircraft N88-23862
Analytical modeling of the structureborne noise path on a small twin-engine aircraft
[NASA-CR-4136] N88-24233

AIRCRAFT WAKES
Propulsive performance of a lifting flapping wing N88-23733

AIRFOILS
In-flight measurement of ice growth on an airfoil using an array of ultrasonic transducers
[AIAA-PAPER-87-0178] N88-23717
High Reynolds number tests of a Douglas DLBA 032 airfoil in the Langley 0.3-meter transonic cryogenic tunnel
[NASA-TM-87663] N88-23734
Boundary-layer stability and airfoil design N88-23738
Wind tunnel testing of low-drag airfoils N88-23741
Flight experiences with laminar flow N88-23744
Preliminary aerodynamic design considerations for advanced laminar flow aircraft configurations N88-23746
Natural laminar flow and airplane stability and control N88-23747

AIRPORT PLANNING
Analyses of heliport system plans
[DOT/FAA/PM-87/31] N88-23810

ALASKA
Influence of the Yukon River on the Bering Sea
[NASA-CR-182802] N88-24126

ALGEBRA
Mahler's method in transcendence theory N88-24227

ALGORITHMS
Experimental evaluation of algorithms for connected speech recognition using hidden Markov models
[RSRE-MEMO-4099] N88-23928
An efficient parallel algorithm for the simulation of three-dimensional compressible transition on a 20 processor Flex/32 multicomputer
[NASA-CR-178340] N88-23943
Shape detection in remote sensing through graph isomorphism N88-24028
Digital processing of infrared and visible images from the GOES satellite and its integration with meteorological radar data N88-24057
Generation of thematic maps for updating aeronautical pilot charts utilizing LANDSAT-TM images N88-24062

Low altitude remote sensing data in the implementation of a mathematical model for the planning of urban equipment networks N88-24074
Research on enhancing the utilization of digital multispectral data and geographic information systems in global habitability studies [NASA-CR-182799] N88-24101
Cloud cover determination in polar regions from satellite imagery [NASA-CR-182906] N88-24123
The multi-disciplinary design study: A life cycle cost algorithm [NASA-CR-4156] N88-24172
On the efficient implementation of the fast multipole algorithm [AD-A191167] N88-24173
Parallel processors and nonlinear structural dynamics algorithms and software [NASA-CR-182925] N88-24187
Genetic algorithms for adaptive real-time control in space systems N88-24195
An algorithm for super-optimal H sup inf design: The 2-block case [OUEL-1711/87] N88-24210
A control technique for improved robot performance N88-24212
Small particle bed reactors: Sensitivity to Brayton cycle parameters N88-24487

ALKALI METALS
AMTEC electrode development N88-24324
Thermochemical analysis of mass transfer in a NB-1ZR-potassium heat pipe N88-24346
Review of alkali metal and refractory alloy compatibility for Rankine cycle applications N88-24447
Alkali metal thermoelectric converter design for space power systems applications N88-24499
A capillary pumped SHE/AMTEC system N88-24500
High power density electrodes for AMTEC N88-24501
Performance of vapor-fed sodium heat engine/AMTEC systems N88-24502

ALKYL COMPOUNDS
The performance of perfluoropolyalkylether oils under boundary lubrication conditions [AD-A191057] N88-23869

ALLOYING
Ion beam alloying of aluminum for corrosion resistance N88-23860

ALLOYS
Noncontact temperature measurement: Requirements and applications for metals and alloys research N88-23899

ALPHA PARTICLES
Spectroscopic data relevant to alpha particle diagnostics N88-24527

ALTERNATING CURRENT
AC impedance analysis of corrosion fatigue in naval aircraft alloys [AD-A190822] N88-23865

ALTIMETERS
Integrated multisensor navigation systems N88-23722

ALTIMETRY
Criteria for planimetric and altimetric correction of maps restituted from aerial photographs in 1:100,000 scale N88-24097

ALUMINUM
Polyitaconic acid macromolecule primer for adhesive bonding and corrosion control of aluminum N88-23849

ALUMINUM ALLOYS
Stress corrosion cracking properties of Al-Li alloys N88-23853
AC impedance analysis of corrosion fatigue in naval aircraft alloys [AD-A190822] N88-23865

ALUMINUM SILICATES
Structure and mechanical properties of metal matrix composites made using semi-solid processes: The case of the system Al-Si/SiC [ETN-88-92299] N88-23836
Mechanical and structural characterization of aluminum ceramic fibers [ETN-88-92168] N88-23870

AMINES
Modification of polymers by photografting processes N88-23871

AMMONIUM COMPOUNDS
Development of microencapsulated DNBM quaternary ammonium inhibitors for paints N88-23851

ANALOG COMPUTERS
Specification for IBM/IBM compatible 3480 tape cartridge [NASA-TM-100702] N88-24168

ANALYSIS (MATHEMATICS)
Application of chaos theory to 1/f noise [AD-A191150] N88-23935
Activities of the Institute for Computer Applications in Science and Engineering (ICASE) [NASA-CR-181666] N88-24166
Analytical modeling of the structureborne noise path on a small twin-engine aircraft [NASA-CR-4136] N88-24233

ANEMOMETERS
Thermal remote anemometer system [NASA-CASE-LAR-13508-1] N88-23962

ANGLE OF ATTACK
Wind-tunnel investigation of actuated forebody strakes for yaw control at high angles of attack N88-23754

ANGULAR CORRELATION
Angular position measurements at high temperatures and high radiation environments N88-24479

ANNEALING
The effect of elevated temperature on irradiated MOS devices N88-24308

ANNIHILATION REACTIONS
Stable, heavy, neutral particles in the sun and in toponium decay N88-24568

ANNUAL VARIATIONS
Latitudinal and seasonal variation of the cloud characteristic parameters and their effects on the cloud classification N88-24005
Sea ice kinematics: Space and time scales [AD-A191162] N88-24128
Examples of ice pack rigidity and mobility characteristics determined from ice motion [AD-A191163] N88-24129

ANODIC COATINGS
AC impedance analysis of corrosion fatigue in naval aircraft alloys [AD-A190822] N88-23865

ANOMALIES
Anomalies in the vegetation in the Alto Xingu - MT N88-24043
Remote sensing and structural rupture: Application examples in the study of tectonics N88-24050

ANTENNA FEEDS
Development of 20 GHz monolithic transmit modules [NASA-CR-182134] N88-24539

ANTICLINES
The breaked anticlines, cuesta and crest homoclines, ortoclinal valleys, and other forms of relief outcrops delineated with the help of remote sensing imagery N88-24089

ANTIFERROMAGNETISM
Comparison between muon spin rotation and neutron scattering studies on the 3-dimensional magnetic ordering of La2CuO(4-y) N88-24244

APPLICATIONS PROGRAMS (COMPUTERS)
Numerical simulation of scramjet inlet flow fields [NASA-TP-2517] N88-23735
Testing complex avionics software: A practical experience N88-23794
Theoretical studies of Resonance Enhanced Stimulated Raman Scattering (RESRS) of frequency doubled Alexandrite laser wavelength in cesium vapor [NASA-CR-182871] N88-23841
Electromagnetic scattering from nonlinear anisotropic cylinders N88-23930
Manual for obscuration code with space station applications [NASA-CR-178099] N88-23931
Numerical modelling of flows using phoenics N88-23955
Theory of neutron moisture probes and interpretation of measurements in complex soil and water systems N88-23965
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24026
The SAGE geographic analysis system N88-24063
COMTAL vision one/20 programming processor system from the VAX 11/780 N88-24079
A control technique for improved robot performance N88-24212
Novel silicon Schottky barrier infrared imaging arrays N88-24510
A benchmark for galactic cosmic ray transport codes [NASA-TM-101157] N88-24571

APPROXIMATION
A new collocation-type method for the numerical solution of Hammerstein equations N88-24226
An evaluation of energy-independent heavy ion transport coefficient approximations [NASA-TM-101158] N88-24251

AQUEOUS SOLUTIONS
Corrosion and fatique properties of FeCrB/Si metallic glass wires in aqueous environments N88-23855

ARC JET ENGINES
Arcjet thruster research and technology, phase 1 [NASA-CR-182107] N88-23830
Electric propulsion options for the SP-100 reference mission N88-24296
Status of high power electric propulsion technology N88-24443

ARC LAMPS
Arc lamp power supply using a voltage multiplier [NASA-CASE-LAR-13202-1] N88-23942

ARC WELDING
Welding torch gas cup extension [NASA-CASE-MFS-29252-1] N88-23980

ARCHAEOLOGY
Subsurface morphology and geoarchaeology revealed by spaceborne and airborne radar N88-24022
Utilization of LANDSAT-TM , for aiding in the localization of archeological sites in the state of Sao Paulo N88-24069

ARCHITECTURE (COMPUTERS)
Architecture and role of the Sensor Subsystem in future aircraft weapon systems N88-23770
Rapid prototyping of complex avionic system architectures N88-23771
Development of a generic architecture N88-23774
Test philosophy of the EH101 integrated avionic N88-23775
The avionics software architecture impact on system architecture N88-23778
A software life cycle support environment N88-23800
Evolution of a family of image processing systems at INPE N88-24065
Integration of symbolic and algorithmic hardware and software for the automation of space station subsystems N88-24190
TALOS: A distributed architecture for intelligent monitoring and anomaly diagnosis of the Hubble Space Telescope N88-24193
Models and metrics for software management and engineering [NASA-CR-182953] N88-24200
A five-layer Open Systems Interconnection (OSI) implementation N88-24204

ARCTIC REGIONS
An investigation of Soviet capabilities in extended range arctic ice forecasting [AD-A191082] N88-24127
Sea ice kinematics: Space and time scales [AD-A191162] N88-24128

ARIANE LAUNCH VEHICLE
Ariane 4 pyrotechnics system: Definition of the chains and pyrotechnic devices [CNES-88/CT/DRT/TVE/IL/25] N88-23816

ARMED FORCES (UNITED STATES)
Defense Small Business Innovation Research Program (SBIR). Volume 3: Air Force abstracts of phase 1 awards, 1987 N88-24548

ARTIFICIAL INTELLIGENCE
Rule-based fault-tolerant flight control N88-23725
Fiber waveguide sensors for intelligent materials [NASA-CR-183026] N88-23968
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24068
Linguistic definition of generic models in computer vision [RSRE-MEMO-4110] N88-24182
MTK: An AI tool for model-based reasoning N88-24189
Simultaneous use of artificial intelligence and Petri nets: Application to the monitoring of a fabrication plan [LAAS-87-354] N88-24207
Notes on artificial intelligence. Part 1: Technical forecast [FOA-C-30448-3.3-PT-1] N88-24208
Energy optimal trajectory planning for robot manipulators and autonomous vehicles N88-24497

ARTIFICIAL SATELLITES
Review of power requirements for satellite remote sensing systems N88-24387

ASTHMA
Mathematical modelling of the heat and water vapour transport in the human respiratory tract N88-24160

ASTRONAUT PERFORMANCE
NASA-Ames workload research program N88-24151

ASTRONAUTS
An investigation of conformable antennas for the astronaut backpack communication system [NASA-CR-182908] N88-23929
Bi-stem gripping apparatus [NASA-CASE-MFS-28185-1] N88-23979

ASTRONOMICAL MODELS
Stochasticity in elliptical galaxies [SER-C-PREPUBL-FASC-20] N88-24556
On the magnetic structure and energy balance of EUV-emitting plasma in the quiet Sun N88-24567

ASTRONOMICAL OBSERVATORIES
LDR structural experiment definition [NASA-TM-100618] N88-23826

ASTRONOMICAL SPECTROSCOPY
The high-throughput X-ray spectroscopy mission E6889478 MN513635 --- ESA program
[ESA-SP-1092] N88-24554
ASTRONOMY
NASA thesaurus: Astronomy vocabulary
[NASA-SP-7069] N88-24553
ASTROPHYSICS
Research and Technology, 1987, Goddard Space Flight Center N88-24572
ASYMMETRY
Stable, heavy, neutral particles in the sun and in toponium decay N88-24568
ASYMPTOTES
Asymptotics for a system of nonlinearly coupled wave equations with an application to the galloping oscillations of overhead transmission lines
[REPT-87-78] N88-23991
ATMOSPHERIC ATTENUATION
Study of the convergence of a finite difference scheme for acoustic propagation in the atmosphere in a parabolic approximation. Statistical calculation of the sound field in the presence of kinematic turbulence
[ONERA-RS-8/3641-PY-160-P] N88-24235
ATMOSPHERIC CHEMISTRY
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125
ATMOSPHERIC CIRCULATION
Open cell associated with warm advection N88-24010
A system for determination of wind fields using geostationary meterological satellites N88-24056
On regime selection in global atmospheric flow N88-24119
Cloud cover determination in polar regions from satellite imagery
[NASA-CR-182906] N88-24123
ATMOSPHERIC EFFECTS
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24020
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24066
Analysis of the parameters responsible for the variations of the illumination conditions in the LANSAT data N88-24070
ATMOSPHERIC ELECTRICITY
Finite element simulation of the atmosphere's electromagnetic response to charge perturbations associated with lightning N88-24124
ATMOSPHERIC MODELS
Chemical kinetics and photochemical data for use in stratospheric modeling evaluation Number 8
[NASA-CR-182919] N88-24012
On regime selection in global atmospheric flow N88-24119
Cloud cover determination in polar regions from satellite imagery
[NASA-CR-182906] N88-24123
The precipitation of energetic heavy ions into the upper atmosphere of Jupiter
[NASA-TM-101155] N88-24565
ATMOSPHERIC RADIATION
Estimation of total Outgoing Longwave Radiation (OLR) flux from geostationary meteorological satellite infrared window radiance N88-24006
ATMOSPHERIC SCATTERING
Temporal analysis of the changes in Parque Estadual de Jacupiranga vegetation through digital treatment of LANDSAT imagery N88-24094
ATMOSPHERIC SOUNDING
Tiros operational vertical sounder (TOVS) and radiosonding in the region N88-24059
ATMOSPHERIC TEMPERATURE
Tiros operational vertical sounder (TOVS) and radiosonding in the region N88-24059
ATMOSPHERIC TURBULENCE
The potential impact on atmospheric ozone and temperature of increasing trace gas concentrations
[NASA-CR-182965] N88-24112
Study of the convergence of a finite difference scheme for acoustic propagation in the atmosphere in a parabolic approximation. Statistical calculation of the sound field in the presence of kinematic turbulence
[ONERA-RS-8/3641-PY-160-P] N88-24235
ATOMIC EXCITATIONS
Density diagnostics by hydrogen line intensity ratios: Excitation cross section between excited states N88-24522
Cascade fluorescences from laser-excited lithium atom for plasma diagnostics N88-24526
Distorted-wave-method calculation of electron-impact excitation of atomic ions N88-24532
ATOMIC STRUCTURE
Point defects in irradiated silicates N88-24319
ATROPHY
Evaluation of the endogenous glucocorticoid hypothesis of denervation atrophy
[NASA-CR-182848] N88-24157
ATTITUDE (INCLINATION)
Minimal parameter solution of the orthogonal matrix differential equation
[NASA-TM-4043] N88-24165
ATTITUDE CONTROL
Three axis attitude control system
[NASA-CASE-GSC-12970-1] N88-23808
AUGMENTATION
Saturation and the limit of jet mixing enhancement by single frequency plane wave excitation: Experiment and theory
[NASA-TM-100882] N88-23732
Application of its transformation in color enhancement of LANDSAT imagery N88-24082
AURORAS
The Jovian aurora: Electron or ion precipitation
[NASA-TM-101153] N88-24566
AUTOMATIC CONTROL
Operation and performance of an integrated helicopter communication system N88-23787
Development of an airborne facility for advanced avionics research N88-23801
A design analysis for an automated robotic workpiece manipulator N88-23975
Integration of symbolic and algorithmic hardware and software for the automation of space station subsystems N88-24190
Connecting remote systems for demonstration of automation technologies N88-24191
Knowledge based system verification and validation as related to automation of space station subsystems: Rationale for a knowledge based system lifecycle N88-24192
Automatic program generation from specifications using PROLOG N88-24196
An optimal disturbance rejection control system for multimegawatt space nuclear power systems N88-24495
Energy optimal trajectory planning for robot manipulators and autonomous vehicles N88-24497
AUTOMATIC PICTURE TRANSMISSION
A low cost automatic Earth observation satellite tracking ground receiving station N88-23815
AUTOMATIC TEST EQUIPMENT
Systems for the 21st century N88-23769
AUXILIARY PROPULSION
A cyclic ground test of an ion auxiliary propulsion system: Description and operational considerations
[NASA-TM-100870] N88-23829
AVALANCHE DIODES
Study for the determination of general and specific properties of wide energy-band gap HgCdTe in the 1 to 2 micrometer wavelength range
[AD-A191091] N88-23934
AVIONICS
Joint University Program for Air Transportation Research, 1986
[NASA-CP-2502] N88-23715
Integrated avionics reliability N88-23723
Integrated Application of Active Controls (IAAC) technology to an advanced subsonic transport project: Program review
[NASA-CR-3880] N88-23763
The Design, Development and Testing of Complex Avionics Systems
[AGARD-CP-417] N88-23767
Technology development program for twenty-first century aerospace vehicles N88-23768
Systems for the 21st century N88-23769
Rapid prototyping of complex avionic system architectures N88-23771
The specification and design of a future maritime reconnaissance aircraft N88-23772
A structured approach to weapon system design N88-23773
Development of a generic architecture N88-23774
Test philosophy of the EH101 integrated avionic N88-23775
Systems engineering technique N88-23776
Modeling of functional specifications for onboard software: Experience with the Rafale avionics system N88-23777
The avionics software architecture impact on system architecture N88-23778
A comparison of integrated and separate systems for flight control and navigation N88-23779
Development and testing of a predictive methodology for optimization of man-machine interface in future avionics systems N88-23780
Crewstation Information and Development System (CIDS) N88-23781
Managing advanced avionic system design N88-23783
Psychosensory cockpit ergonomics, advantages of intelligent information systems N88-23784
Advanced development of a cockpit automation design support system N88-23785
Design and development of an avionics system adapted to helicopter missions N88-23786
Operation and performance of an integrated helicopter communication system N88-23787
Designing for design effectiveness of complex avionics systems N88-23788
Design for interoperability (interchangeability) N88-23789
The electromagnetic threat to future avionic systems N88-23790
The integration, characterisation and trialling of a modern complex airborne radar N88-23791
Experience in the integration of human engineering effort with avionics systems development N88-23793
Testing complex avionics software: A practical experience N88-23794
A look toward the future of complex avionics systems development using the USAF Test Pilot School's avionics systems test training aircraft N88-23797
Software engineering for the British Aerospace Experimental Aircraft Programme (EAP) N88-23798
Avionics systems: Development method and computer tools N88-23799
Development of an airborne facility for advanced avionics research N88-23801
Workshops for the design of avionics systems and the development of onboard software N88-23802
Coherent functional development: Key to successful future system integration N88-23803
Development of complex avionics systems: Experience from French military programs N88-23804
AXIAL FLOW
Hydrogen turbines for space power systems: A simplified axial flow gas turbine model N88-24385
AXIAL FLOW PUMPS
Rotor self-lubricating axial stop
[NASA-CASE-MFS-28273-1] N88-23974
AXISYMMETRIC FLOW
Saturation and the limit of jet mixing enhancement by single frequency plane wave excitation: Experiment and theory
[NASA-TM-100882] N88-23732

B

BACKGROUND NOISE
Sources and levels of background noise in the NASA Ames 40- by 80-foot wind tunnel
[NASA-TM-100077] N88-24239
BACKGROUND RADIATION
Sky radiance distributions for thermal imaging backgrounds
[AD-A191135] N88-24115
BACKSCATTERING
Radar penetration in the Amazonian rain forest N88-24044
BACTERIA
Saccharification of cellulose by combined fungal and bacterial preparations N88-23833
BALANCING
Botany Facility: Considerations and analyses of the balancing system philosophy proposed for the BF centrifuge
[SIRA-A/7373/WP110/PWF001] N88-24139
BALLOON-BORNE INSTRUMENTS
Balloon-borne three-meter telescope for far-infrared and submillimeter astronomy
[NASA-CR-182924] N88-24550
BARRIER LAYERS
A review of diffusion barrier technology for application in SP-100 fuel pins N88-24328
Fabrication of SP-100 fuel barrier structures by chemical vapor deposition N88-24371
BASE FLOW
Study of a system for reducing base drag by controlling vortices
[REPT-87/43] N88-23730
BEADS
Unsteady flow about cambered plates
[AD-A191226] N88-23945
BEAM INJECTION
Ion temperature profile measurement using charge exchange recombination spectroscopy on JIPP T-IIU N88-24518
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D N88-24519
Spectroscopic study of heliotron E plasmas: Stark profile, CXR, poloidal rotation and carbon coating N88-24523

BEAMS (SUPPORTS)
Bi-stem gripping apparatus
[NASA-CASE-MFS-28185-1] N88-23979
Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness
[NASA-TP-2697] N88-23988
BEAUFORT SEA (NORTH AMERICA)
Examples of ice pack rigidity and mobility characteristics determined from ice motion
[AD-A191163] N88-24129
BEDS (PROCESS ENGINEERING)
Theoretical prediction of single phase turbulent flow distribution in particulate bed reactors N88-24386
BENDING
Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness
[NASA-TP-2697] N88-23988
BENDING VIBRATION
Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness
[NASA-TP-2697] N88-23988
BERING SEA
Influence of the Yukon River on the Bering Sea
[NASA-CR-182802] N88-24126
BERYLLIUM OXIDES
Gas core reactors for direct nuclear propulsion N88-24442
BIBLIOGRAPHIES
Engine structures: A bibliography of Lewis Research Center's research for 1980-1987
[NASA-TM-100842] N88-24002
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 311)
[NASA-SP-7011(311)] N88-24161
BINARY CODES
Parallel binary and parallel coded decimal time code formats
[AD-A190126] N88-24170
BINARY STARS
A model for the X-ray binary 4U1820-30
[NASA-TM-101143] N88-24562
Colliding stellar winds in the eclipsing Wolf-Rayet binary V444 Cygni
[NASA-CR-182937] N88-24563
BIOCONVERSION
ECUT (Energy Conversion and Utilization Technologies) program: Biocatalysis Project
[NASA-CR-182917] N88-24110
BIOENGINEERING
ECUT (Energy Conversion and Utilization Technologies) program: Biocatalysis Project
[NASA-CR-182917] N88-24110
BIOINSTRUMENTATION
Clinical applications of computerized thermography N88-23915
BIOLOGICAL EFFECTS
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 311)
[NASA-SP-7011(311)] N88-24161
BIOMASS
The use of SLAR and SIRA imagenes for the classification of forest typen in tropical rain forests N88-24036
BIOPROCESSING
Separation of biological materials in microgravity
[NASA-TM-101142] N88-23916
BIOTECHNOLOGY
Non-contact temperature measurements for biotechnology discipline working group N88-23904
BIOTITE
An integrated study of the Alto Paranaiba Kimberlite Province, Minas Gerais, Brazil: A possible tool for diamond exploration N88-24031
BIPOLAR TRANSISTORS
Neutron effects on the electrical and switching characteristics of NPN bipolar power transistors N88-24463
BOILING
Analysis and interpretation of low gravity boiling experiments in the KC-135 N88-24466
BOLTS
Bearing-bypass material system test
[NASA-CASE-LAR-13458-1] N88-23967
BOSONS
Stable, heavy, neutral particles in the sun and in toponium decay N88-24568
BOTANY
Botany Facility pre-phase C/D. Core payload for EURECA, volume 2
[BF-RP-ER-015-VOL-2] N88-24130
Life Support Subsystem (LSS). Concept for the Botany Facility --- EURECA
[TN-RB524-107/86] N88-24131
Impact of control errors on the volume/weight demand of the Ventilation and Dryer (VAD) concept --- EURECA Botany Facility
[TN-RB524-006/87] N88-24132
Summary of the activities performed during the Botany Facility (BF) predevelopment phase for the Life Support S/S (LSS)
[TB-RB524-002/87] N88-24133
Botany Facility. Thermal Control (TC) subsystem test report on experiment container of laboratory model and breadboard centrifuge
[BF-TN-ER-061/86] N88-24135
Botany Facility: Test report on breadboard tests for the determination of the heat transfer at the glass disk and of the temperature distribution in the fluorescent tube
[BF-TN-ER-053] N88-24136
Botany Facility: Breadboarding results of the illumination system
[SIRA-A/7373/WP110/MAC003] N88-24137
Botany Facility: Magnetic fluid seal considerations for the centrifuge
[SIRA-A/7373/WP110/MAC004] N88-24138
Botany Facility: Considerations and analyses of the balancing system philosophy proposed for the BF centrifuge
[SIRA-A/7373/WP110/PWF001] N88-24139
Botany Facility: The problems of plant fixation
[SIRA-A/7373/WP220/RJS/001] N88-24140
Botany Facility: Problems of water supply, plant nutrients and soil in the Botany Facility
[SIRA-A/7373/WP220/RJS/003] N88-24141
Supply and distribution of plant nutrients in the Botany Facility
[SIRA-A/7373/WP220/RJS/004] N88-24142
EURECA Botany Facility. Technical note: Removal of phytotoxins
[SIRA-A/7373/WP220/RJS/005] N88-24143
Botany Facility pre-phase C/D. Core payload for EURECA, volume 1
[BF-RP-ER-015-VOL-1] N88-24144
BOUNDARY LAYER CONTROL
An assessment of the drag reduction properties of riblets and the penalties of off-design conditions
[RAE-TM-AERO-2113] N88-23731
Boundary-layer stability and airfoil design N88-23738
Wind tunnel testing of low-drag airfoils N88-23741
Operational considerations for laminar flow aircraft N88-23748
Pressure distributions from subsonic tests of an advanced laminar-flow-control wing with leading- and trailing-edge flaps
[NASA-TM-4040-PT-1] N88-23758
BOUNDARY LAYER FLOW
Single phase liquid immersion cooling of discrete heat sources in a vertical channel
[AD-A191224] N88-23944
Unsteady flow about cambered plates
[AD-A191226] N88-23945
Surface curvature and pressure gradient effects on turbulent flow: An assessment based on numerical solution of the Reynolds equations N88-23954
BOUNDARY LAYER SEPARATION
Unsteady flow about cambered plates
[AD-A191226] N88-23945
Accounting for the effects of unsteady, separated boundary layers in transonic two dimensional calculations
[ONERA-RT-30/3064-RY-063-R] N88-23952
BOUNDARY LAYER STABILITY
Boundary-layer stability and airfoil design N88-23738
Wind tunnel testing of low-drag airfoils N88-23741
BOUNDARY LAYER TRANSITION
Boundary layer measurements using hot-film sensors N88-23743
Natural laminar flow and airplane stability and control N88-23747
Certification aspects of airplanes which may operate with significant natural laminar flow N88-23749
Crossflow vorticity sensor
[NASA-CASE-LAR-13436-1-CU] N88-23759
BOUNDARY LAYERS
High Reynolds number tests of a Douglas DLBA 032 airfoil in the Langley 0.3-meter transonic cryogenic tunnel
[NASA-TM-87663] N88-23734
Boundary layer measurements using hot-film sensors N88-23743
Unsteady flow about cambered plates
[AD-A191226] N88-23945
BOUNDARY LUBRICATION
The performance of perfluoropolyalkylether oils under boundary lubrication conditions
[AD-A191057] N88-23869
BOUNDARY VALUE PROBLEMS
Parameter estimation for boundary value problems by integral equations of the second kind
[NASA-CR-181680] N88-23918
BRACKETS
Locking hinge
[NASA-CASE-MSC-21056-1] N88-23827
BRAYTON CYCLE
Speculations on future opportunities to evolve Brayton powerplants aboard the space station N88-24258
Characteristics of the closed Brayton cycle for dynamic isotope power systems N88-24401
Dynamic isotope power system critical component verification N88-24421
SNAP-DYN: Proven technology for wear-term, higher power in space N88-24422
The closed Brayton cycle: An energy conversion system for near-term military space missions N88-24488
The effect of operating temperature and turbine blade cooling on Brayton cycle space power systems N88-24489
A combined Rankine/Brayton pulse power cycle N88-24490
Energy conversion system optimization study for multimegawatt space nuclear power application N88-24492
BREADBOARD MODELS
Botany Facility. Thermal Control (TC) subsystem test report on experiment container of laboratory model and breadboard centrifuge
[BF-TN-ER-061/86] N88-24135
Botany Facility: Test report on breadboard tests for the determination of the heat transfer at the glass disk and of the temperature distribution in the fluorescent tube
[BF-TN-ER-053] N88-24136
Botany Facility: Breadboarding results of the illumination system
[SIRA-A/7373/WP110/MAC003] N88-24137
BREMSSTRAHLUNG
Measurements of Z(sub eff) profile with a visible bremsstrahlung continuum detector array N88-24529
Spectral modelling of the soft gamma ray repeater
[DE88-007027] N88-24570
BRIGHTNESS
Mapping soil and rock variation from satellite images in the Sahel N88-24023
BRIGHTNESS TEMPERATURE
The NBS scale of radiance temperature N88-23897
BRITTLENESS
Some design considerations for ceramic components in heat engine applications N88-23875
BUBBLES
The structure and stability of spherically expanding flames N88-23842
BUCKLING
Local buckling and crippling of composite stiffener sections
[NASA-TM-101133] N88-23840
BUFFETING
Numerical method for unsteady viscous-inviscid interaction to calculate buffeting
[ONERA-RSF-02/3617-AY-008-A] N88-23949
BUOYS
Comparison of surface current determined from satellite-tracked buoy with shipboard wind data during the 4th Brazilian antarctic expedition, 10-14 March, 1986 N88-24024
Near surface current determined from INPE's satellite-tracked buoy, during 6-26 November, 1985 N88-24058
BUS CONDUCTORS
Lightweight power bus for a baseload nuclear reactor in space N88-24505

C

C-135 AIRCRAFT
Reduced-gravity two-phase flow experiments in the NASA KC-135 N88-24465
Analysis and interpretation of low gravity boiling experiments in the KC-135 N88-24466
CADASTRAL MAPPING
The Systeme d'Analyse Geographique (SAGE) geographic analysis system N88-24019
The SAGE geographic analysis system N88-24063
CALIBRATING
Preparation and execution of calibration measurements for handling of airborne SAR data (AGRISAR)
[ETN-88-92338] N88-23926
A control technique for improved robot performance N88-24212
Johnson noise thermometer for high-radiation and high-temperature environments N88-24480
Intensity calibration of a VUV system by branching line pairs N88-24533

CALIFORNIA
Soil erosion and causative factors at Vandenberg Air Force Base, California
[NASA-TM-100981] N88-24156

CAMERAS
The modeling of error budget analysis and tolerance specifications for BRESEX multiband linear array CCD camera N88-24029

CANARD CONFIGURATIONS
Preliminary aerodynamic design considerations for advanced laminar flow aircraft configurations N88-23748

CANOPIES (VEGETATION)
Radar penetration in the Amazonian rain forest N88-24015
Radar penetration in the Amazonian rain forest N88-24044
Structure and dynamics of vegetation in the middle semi-arid tropics. Quixaba's Caatinga (PE): Terrain analysis of MSS/LANDSAT data N88-24049

CARBIDES
A comparison of uranium nitride and mixed carbide fuels swelling N88-24485

CARBON
Krypton based adsorption type cryogenic refrigerator
[NASA-CASE-NPO-17334-1-CU] N88-23917
Cryogenic regenerator including saran-carbon heat conduction matrix
[NASA-CASE-NPO-17291-1-CU] N88-23946

CARBON DIOXIDE LASERS
Engineering planetary lasers for interstellar communication
[NASA-CR-180780] N88-23825

CARBON FIBER REINFORCED PLASTICS
Investigation of the long term effects of aging on carbon epoxy composites exposed naturally to the weather under cyclic loads. (Results of sampling after 2.5 years). Test report M1-641300
[CEAT-39/M/79-C-M1-641300] N88-23834
GARTEUR TP-037: Impact damage tolerance of carbon fiber and hybrid laminates
[RAE-TR-87057] N88-23837

CARBON FIBERS
High-temperature thermal conductivity of a carbon-bonded carbon-fiber insulation N88-24281

CARBON-CARBON COMPOSITES
Composite piston
[NASA-CASE-LAR-13435-1] N88-23981

CARBONIZATION
Disclination structures in carbon and graphite
[AD-A191056] N88-23868

CARBOXYLATES
Carboxylate formation at the interface between a polyimide coating and cobalt N88-23859

CARRIER INJECTION
Neutron radiation tolerance of Au-activated silicon N88-24316

CARTAN SPACE
Raychaudhuri equation in the self-consistent Einstein-Cartan theory with spin-density
[NASA-TM-101145] N88-24546
Inflation in Einstein-Cartan theory with energy-momentum tensor with spin
[NASA-TM-101164] N88-24547

CASTING
Structure and mechanical properties of metal matrix composites made using semi-solid processes: The case of the system Al-Si/SiC
[ETN-88-92299] N88-23836
Compositional redistribution during casting of Hg sub 0.8 Cd sub 0.2 Te alloys
[NASA-TM-101151] N88-23893
Fabrication of reactor shields at the Y-12 plant N88-24283

CATALYSIS
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844
ECUT (Energy Conversion and Utilization Technologies) program: Biocatalysis Project
[NASA-CR-182917] N88-24110

CATALYSTS
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844

CAVITATION FLOW
Modeling of cavitation phenomena in homogeneous flow in transitory regimes in pipes
[ISAL-IDI1-87-15] N88-23948

CELLULOSE
Saccharification of cellulose by combined fungal and bacterial preparations N88-23833

CENSORED DATA (MATHEMATICS)
Survival analysis, or what to do with upper limits in astronomical surveys
[NASA-CR-182936] N88-24551

CENTERBODIES
Multi-body aircraft with an all-movable center fuselage actively controlling fuselage pressure drag
[NASA-CASE-LAR-13511-1] N88-23765

CENTRAL PROCESSING UNITS
Simulation: A simulation system in Ada
[FOA-A-20043-2.7] N88-24176

CENTRIFUGAL FORCE
Centrifugal acceleration of ions in the polar magnetosphere
[NASA-TM-101148] N88-24120

CENTRIFUGES
Botany Facility. Thermal Control (TC) subsystem test report on experiment container of laboratory model and breadboard centrifuge
[BF-TN-ER-061/86] N88-24135
Botany Facility: Magnetic fluid seal considerations for the centrifuge
[SIRA-A/7373/WP110/MAC004] N88-24138
Botany Facility: Considerations and analyses of the balancing system philosophy proposed for the BF centrifuge
[SIRA-A/7373/WP110/PWF001] N88-24139

CERAMIC BONDING
Composite piston
[NASA-CASE-LAR-13435-1] N88-23981

CERAMIC COATINGS
Recent advances in metallic/ceramic coatings for corrosion control in military applications N88-23858
Vanadic hot corrosion of gas turbine blade coating materials N88-23864

CERAMIC FIBERS
Mechanical and structural characterization of aluminum ceramic fibers
[ETN-88-92168] N88-23870
SiC fiber analysis N88-23891
SiC fiber reinforced reaction-bonded Si3N4 composites N88-23892
Development of materials for fabric radiators N88-24448

CERAMIC MATRIX COMPOSITES
Ceramic matrix composites N88-23888

CERAMIC NUCLEAR FUELS
Cermet fuel thermal conductivity N88-24329
Monolithic fuel cell based power source for burst power generation N88-24450

CERAMICS
Structural Ceramics
[NASA-CP-2427] N88-23872
Ceramics for turbine engines N88-23873
Friction and wear of ceramics N88-23874
Some design considerations for ceramic components in heat engine applications N88-23875
Nondestructive evaluation of structural ceramics N88-23876
Fracture mechanics N88-23877
Structural ceramics research N88-23878
Nondestructive Evaluation (NDE) of structural ceramics by photoacoustic microscopy N88-23884
Molten salt corrosion of SiC and Si3N4 N88-23885
Thermal cyclic durability testing of ceramic materials for turbine engines N88-23886
Fractographic and microstructural evaluation of 3500-hour durability specimens N88-23887
Polymer precursors for ceramic composites N88-23890
Fabric radiators N88-24435
Ceramic electrical insulator development for thermoelectric SACE power system N88-24459
Apparatus for the measurement of resistivity of glasses and ceramics N88-24480

CERIUM COMPOUNDS
Coexisting static magnetic ordering and superconductivity in CeCu2.1Si2 found by muon spin relaxation N88-24245
Static magnetic ordering of CeCu2.1Si2 found by muon spin relaxation N88-24246

CERMETS
Cermet fuel thermal conductivity N88-24329
Molybdenum-base cermet fuel development N88-24481

CERTIFICATION
Laminar Flow Aircraft Certification
[NASA-CP-2413] N88-23737
Certification aspects of airplanes which may operate with significant natural laminar flow N88-23749

CESIUM
Theoretical studies of Resonance Enhanced Stimulated Raman Scattering (RESRS) of frequency doubled Alexandrite laser wavelength in cesium vapor
[NASA-CR-182871] N88-23841

CHANNELS (DATA TRANSMISSION)
DATAC bus monitor N88-23721
Design for interoperability (interchangeability) N88-23789

CHAOS
Application of chaos theory to 1/f noise
[AD-A191150] N88-23935

CHARACTERIZATION
The integration, characterisation and trialling of a modern complex airborne radar N88-23791
Mechanical and structural characterization of aluminum ceramic fibers
[ETN-88-92168] N88-23870
High frequency ultrasonic characterization of sintered SiC
[NASA-TM-100825] N88-23985

CHARGE CARRIERS
Systematic variation of magnetic-field penetration depth in high-T(c) superconductors studied by muon spin relaxation N88-24243

CHARGE COUPLED DEVICES
Novel silicon Schottky barrier infrared imaging arrays N88-24510

CHARGE DISTRIBUTION
Measurements of Z(sub eff) profile with a visible bremsstrahlung continuum detector array N88-24529

CHARGE EXCHANGE
Ion temperature profile measurement using charge exchange recombination spectroscopy on JIPP T-IIU N88-24518
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D N88-24519
Spectroscopic study of heliotron E plasmas: Stark profile, CXR, poloidal rotation and carbon coating N88-24523

CHEMICAL ANALYSIS
Identification of hydroxypropyl starch hydrolysate components N88-23832
Analysis of thermal and radiation effects in materials using the GEMAT process N88-24318
Thermochemical analysis of mass transfer in a NB-1ZR-potassium heat pipe N88-24346

CHEMICAL ATTACK
Corrosion of tungsten alloys in marine environments N88-23854

CHEMICAL BONDS
Polyitaconic acid macromolecule primer for adhesive bonding and corrosion control of aluminum N88-23849

CHEMICAL CLEANING
Ammonia cleanup of lithium containing components N88-24287

CHEMICAL COMPOSITION
Identification of hydroxypropyl starch hydrolysate components N88-23832
Hydrogen embrittlement susceptibility of high strength ESR 4340 steel alloys for ballistically resistant/tolerant components N88-23848
Compositional redistribution during casting of Hg sub 0.8 Cd sub 0.2 Te alloys
[NASA-TM-101151] N88-23893

CHEMICAL EQUILIBRIUM
Thermochemical analysis of mass transfer in a NB-1ZR-potassium heat pipe N88-24346

CHEMICAL PROPULSION
Comparison of a direct thrust nuclear engine, nuclear electric engine and a chemical engine for future space missions N88-24379

CHEMICAL REACTIONS
Preventing aircraft corrosion by predictive corrosion modeling N88-23863
Chemical kinetics and photochemical data for use in stratospheric modeling evaluation Number 8
[NASA-CR-182919] N88-24012

CHIPS (ELECTRONICS)
A five-layer Open Systems Interconnection (OSI) implementation N88-24204
Development of 20 GHz monolithic transmit modules
[NASA-CR-182134] N88-24539

CHLOROCARBONS
The potential impact on atmospheric ozone and temperature of increasing trace gas concentrations
[NASA-CR-182965] N88-24112

CHROMATES
Recent advances in metallic/ceramic coatings for corrosion control in military applications N88-23858

CIRCLES (GEOMETRY)
Fitting a circle to radially suppressed data
[NPL-DITC-103/87] N88-24223

CIVIL AVIATION
The challenges and opportunities of supersonic transport propulsion technology
[NASA-TM-100921] N88-23806

CLADDING
Parametric analyses of the TE SP-100 system performance N88-24358
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428
SNAP fuel performance N88-24484

CLASSIFICATIONS
Latitudinal and seasonal variation of the cloud characteristic parameters and their effects on the cloud classification N88-24005
The use of SLAR and SIRA imagenes for the classification of forest typen in tropical rain forests N88-24036
Utilization of TM/LANDSAT images in the implanted forests mapping in the Mogi-Guacu Region (SP-Brazil) N88-24042
Generation of thematic maps for updating aeronautical pilot charts utilizing LANDSAT-TM images N88-24062
Study of methods of post-processing applied to a problem of standard classification N88-24067
Research on enhancing the utilization of digital multispectral data and geographic information systems in global habitability studies
[NASA-CR-182799] N88-24101
CLIMATE CHANGE
On regime selection in global atmospheric flow N88-24119
CLIMATOLOGY
Outline of the GPCP strategy N88-24007
Research and Technology, 1987, Goddard Space Flight Center N88-24572
CLINICAL MEDICINE
Clinical applications of computerized thermography N88-23915
Design considerations for the development of an implantable sensor for the continuous measurement of glucose in the diabetic patient N88-24159
CLOSED CYCLES
Analysis of closed cycle megawatt class space power systems with nuclear reactor heat sources N88-24351
Comparison of open and closed multimegawatt space power systems N88-24353
Characteristics of the closed Brayton cycle for dynamic isotope power systems N88-24401
CLOUD COVER
Comparison of the solar radiation estimation method by satellites N88-24055
Restrictions in activity monitoring through remote sensing N88-24084
Cloud cover determination in polar regions from satellite imagery
[NASA-CR-182906] N88-24123
CLOUD GLACIATION
Experimental measurements of heat transfer from an iced surface during artificial and natural cloud icing conditions
[AIAA-PAPER-88-1352] N88-23718
CLOUD PHOTOGRAPHY
Enhanced infra-red picture of LR-FAX for spring and autumn seasons N88-24011
CLOUDS (METEOROLOGY)
Latitudinal and seasonal variation of the cloud characteristic parameters and their effects on the cloud classification N88-24005
A system for determination of wind fields using geostationary meterological satellites N88-24056
CMOS
Microelectronics the next fifteen years N88-23792
COASTAL CURRENTS
Influence of the Yukon River on the Bering Sea
[NASA-CR-182802] N88-24126
COASTAL WATER
Influence of the Yukon River on the Bering Sea
[NASA-CR-182802] N88-24126
COATINGS
Boundary layer flow visualization for flight testing N88-23742
COBALT
Carboxylate formation at the interface between a polyimide coating and cobalt N88-23859
COCKPITS
Psychosensory cockpit ergonomics, advantages of intelligent information systems N88-23784
Advanced development of a cockpit automation design support system N88-23785
Software engineering for the British Aerospace Experimental Aircraft Programme (EAP) N88-23798
CODING
Error control techniques for satellite and space communications
[NASA-CR-182886] N88-23922
Preliminary 2-D shell analysis of the space shuttle solid rocket boosters
[NASA-TM-100515] N88-23989
Parallel binary and parallel coded decimal time code formats
[AD-A190126] N88-24170
The Lewis heat pipe code with application to SP-100 GES heat pipes N88-24395
COGNITION
Spatial cognition N88-24152
Induction of models under uncertainty
[NASA-TM-101173] N88-24230
COINCIDENCE CIRCUITS
Coincidence counting corrections under conditions used by A. DeVolpi
[NPL-RS(EXT)90] N88-24224
COLLIMATION
Ion generator and ion application system
[NASA-CASE-MFS-28122-1] N88-24253
COLLISION AVOIDANCE
UK airmiss statistics
[CAA-1/87] N88-23761
Orbital navigation, docking and obstacle avoidance as a form of three dimensional model-based image understanding N88-24194
Nuclear-powered space debris sweeper N88-24380
COLLISIONS
Colliding stellar winds in the eclipsing Wolf-Rayet binary V444 Cygni
[NASA-CR-182937] N88-24563
COLLOCATION
A new collocation-type method for the numerical solution of Hammerstein equations N88-24226
COLLOIDS
Colloidal characterization of silicon nitride and silicon carbide N88-23883
COLOR
Application of its transformation in color enhancement of LANDSAT imagery N88-24082
Evaluation of TM false color composites for crop discrimination N88-24096
COLOR PHOTOGRAPHY
Conversational Analysis of Color Images (CAICOU): An interactive development system for the analysis of color images
[RR-641-I-IMAG-39-LIFIA] N88-23964
Anomalies in the vegetation in the Alto Xingu - MT N88-24043
Remote sensing techniques in the estimation of the area cultivated with beans, corn, and castor beans in the Irece County (Bahia State) N88-24045
COLORIMETRY
Note on the double crystal method of measuring heat transfer coefficient
[OUEL-1710/87] N88-23950
COLUMBUS SPACE STATION
Colombus feasibility studies, executive summary
[ETN-88-92334] N88-23820
COMBUSTION CONTROL
Control of combustion and acoustically coupled fluid dynamic instabilities N88-23843
COMBUSTION PHYSICS
Microgravity combustion discipline working group summary of requirements for noncontact temperature measurements N88-23902
Requirements for temperature and species concentration measurements in microgravity combustion experiments N88-23903
Laser Diagnostics for combustion temperature and species measurements N88-23912
COMMAND LANGUAGES
A robotic language for cooperative multi-robots N88-24186
COMMERCIAL AIRCRAFT
Manufacturing requirements N88-23745
COMMUNICATION
The relationship between group process and performance N88-24549
COMMUNICATION NETWORKS
Modeling, filtering and control of stochastic processes --- communication networks
[ENST-87E021] N88-23925
MSAT-X: A technical introduction and status report
[NASA-CR-182921] N88-23933
Connecting remote systems for demonstration of automation technologies N88-24191
COMMUNICATION SATELLITES
MSAT-X: A technical introduction and status report
[NASA-CR-182921] N88-23933
COMPARISON
Comparison of a direct thrust nuclear engine, nuclear electric engine and a chemical engine for future space missions N88-24379
COMPILERS
A timing evaluator for C programs generated by the model system
[AD-A191204] N88-24174
COMPLEX SYSTEMS
Systems engineering technique N88-23776
COMPONENT RELIABILITY
Pioneer 10 and 11 RTG performance update N88-24301
Dynamic isotope power system critical component verification N88-24421
COMPOSITE MATERIALS
Strain intensity factor approach for predicting the strength of continuously reinforced metal matrix composites
[NASA-TM-100617] N88-23838
Local buckling and crippling of composite stiffener sections
[NASA-TM-101133] N88-23840
Cryogenic regenerator including saran-carbon heat conduction matrix
[NASA-CASE-NPO-17291-1-CU] N88-23946
COMPOSITE STRUCTURES
Insert design handbook
[ESA-PSS-03-1202-ISSUE-1] N88-23822
Composite piston
[NASA-CASE-LAR-13435-1] N88-23981
COMPRESSIBLE FLOW
Detailed transient model of a liquid-metal heat pipe N88-24345
COMPRESSIBLE FLUIDS
A compressible vapor flux model for transient heat pipe analysis N88-24343
COMPRESSING
Dynamic range compression/expansion of light beams by photorefractive crystals
[NASA-CASE-NPO-17140-1-CU] N88-24508
COMPRESSION TESTS
Bearing-bypass material system test
[NASA-CASE-LAR-13458-1] N88-23967
COMPUTATION
Scientific computing environments
[AD-A191239] N88-24175
The exact calculation of quadrupole sources for some incompressible flows
[NASA-TM-100623] N88-24240
COMPUTATIONAL FLUID DYNAMICS
Methodology for matching experimental and computational aerodynamic data
[NASA-TM-100592] N88-23728
Numerical simulation of scramjet inlet flow fields
[NASA-TP-2517] N88-23735
An efficient parallel algorithm for the simulation of three-dimensional compressible transition on a 20 processor Flex/32 multicomputer
[NASA-CR-178340] N88-23943
Numerical method for unsteady viscous-inviscid interaction to calculate buffeting
[ONERA-RSF-02/3617-AY-008-A] N88-23949
Development and improvement of a code to calculate small, three dimensional, unsteady transonic perturbations
[ONERA-RTS-31/3064-RY-062-R] N88-23951
Accounting for the effects of unsteady, separated boundary layers in transonic two dimensional calculations
[ONERA-RT-30/3064-RY-063-R] N88-23952
Surface curvature and pressure gradient effects on turbulent flow: An assessment based on numerical solution of the Reynolds equations N88-23954
Numerical modelling of flows using phoenics N88-23955
COMPUTER AIDED DESIGN
It's time to reinvent the general aviation airplane N88-23726
Computational wing design studies relating to natural laminar flow N88-23740
The Design, Development and Testing of Complex Avionics Systems
[AGARD-CP-417] N88-23767
Rapid prototyping of complex avionic system architectures N88-23771
The avionics software architecture impact on system architecture N88-23778
Managing advanced avionic system design N88-23783
Advanced development of a cockpit automation design support system N88-23785
Design and development of an avionics system adapted to helicopter missions N88-23786
Developing systems using state-of-the-art CAD/CAM technology N88-23795
Interfacing and integrating hardware and software design systems N88-23796
Avionics systems: Development method and computer tools N88-23799
A software life cycle support environment N88-23800
Coherent functional development: Key to successful future system integration N88-23803
A software design tool for the analysis of robot dynamics properties
[NLR-MP-86064-4] N88-24171
Simulation and computer aided engineering (the necessity of an integrated approach)
[NLR-MP-86050-U] N88-24178
Expert systems approach to modeling systems with the ATHENA thermal-hydraulics code N88-24365

COMPUTER AIDED MANUFACTURING
Developing systems using state-of-the-art CAD/CAM technology N88-23795
Simulation and computer aided engineering (the necessity of an integrated approach) [NLR-MP-86050-U] N88-24178
COMPUTER AIDED MAPPING
Presentation of map information on a color display [FOA-C-20687-2.7] N88-24103
Coupling of satellite remote sensing to digitized topographic map to detect changes in land use [B8735129] N88-24104
Digital monoplotting, part 1 [B8735122-PT-1] N88-24106
Digital monoplotting, part 2 [B8735122-PT-2] N88-24107
COMPUTER COMPONENTS
Real time pipelined system for forming the sum of products in the processing of video data [NASA-CASE-NPO-16462-1-CU] N88-24169
COMPUTER GRAPHICS
The geometric workstation, a new approach for geometric corrections of remotely sensed data N88-24017
The Systeme d'Analyse Geographique (SAGE) geographic analysis system N88-24019
Evolution of a family of image processing systems at INPE N88-24065
Automatic registration of satellite imagery N88-24080
Visualization of digital terrain models N88-24081
Presentation of map information on a color display [FOA-C-20687-2.7] N88-24103
Graphics software tool for VT terminals (VTGRAPH) [NASA-TM-100331] N88-24201
Description of graphics translation software between Intergraph and Tektronix systems [NASA-TM-100335] N88-24202
COMPUTER INFORMATION SECURITY
Protection and security mechanisms in the SMITE capability computer [RSRE-MEMO-4117] N88-24167
Development environment for secure software [RSRE-87015] N88-24179
Separability and security models — software [RSRE-87020] N88-24180
COMPUTER PROGRAM INTEGRITY
Development environment for secure software [RSRE-87015] N88-24179
Separability and security models — software [RSRE-87020] N88-24180
COMPUTER PROGRAMMING
Mapping from LANDSAT and SPOT satellite imagery N88-24018
The SAGE geographic analysis system N88-24063
The Environment for Application Software Integration and Execution (EASIE) version 1.0. Volume 4: System installation and maintenance guide [NASA-TM-100576] N88-24185
COMPUTER PROGRAMS
PAN AIR analysis of the NASA/MCAIR 279-3: An advanced supersonic V/STOL fighter/attack aircraft [NASA-TM-86838] N88-23750
Modeling of functional specifications for onboard software: Experience with the Rafale avionics system N88-23777
The avionics software architecture impact on system architecture N88-23778
Workshops for the design of avionics systems and the development of onboard software N88-23802
EnviroNET: An interactive space-environment information resource [NASA-TM-101137] N88-23812
Preventing aircraft corrosion by predictive corrosion modeling N88-23863
Preliminary 2-D shell analysis of the space shuttle solid rocket boosters [NASA-TM-100515] N88-23989
The multi-disciplinary design study: A life cycle cost algorithm [NASA-CR-4156] N88-24172
A timing evaluator for C programs generated by the model system [AD-A191204] N88-24174
MIPS: The good, the bad and the useful [NASA-CR-182893] N88-24184
A robotic language for cooperative multi-robots N88-24186
Third Conference on Artificial Intelligence for Space Applications, part 2 [NASA-CP-2492-PT-2] N88-24188
Automatic program generation from specifications using PROLOG N88-24196
TES: A modular systems approach to expert system development for real-time space applications N88-24197
Mentat: An object-oriented macro data flow system [NASA-TM-101165] N88-24199
Description of graphics translation software between Intergraph and Tektronix systems [NASA-TM-100335] N88-24202
Cermet fuel thermal conductivity N88-24329
ATHENA simulation of the 300 kW SP-100 N88-24357
Expert systems approach to modeling systems with the ATHENA thermal-hydraulics code N88-24365
SP-100 system modeling: SNPSAM update N88-24372
The Lewis heat pipe code with application to SP-100 GES heat pipes N88-24395
HTPIPE: A steady state heat pipe analysis program N88-24396
The THROHPUT code: Thermohydraulic heat pipe modeling N88-24399
MACRAD: A mass analysis code for radiators N88-24418
Energy storage evaluation for burst power applications N88-24430
Space Power Reference Source (SPRS): A user's guide to SDI Space Power Technology Programs N88-24440
Transient analyses of multimegawatt space reactors N88-24456
COMPUTER SYSTEMS DESIGN
Activities of the Institute for Computer Applications in Science and Engineering (ICASE) [NASA-CR-181666] N88-24166
Protection and security mechanisms in the SMITE capability computer [RSRE-MEMO-4117] N88-24167
Simulation and computer aided engineering (the necessity of an integrated approach) [NLR-MP-86050-U] N88-24178
MIPS: The good, the bad and the useful [NASA-CR-182893] N88-24184
Interconnection of high-speed local area networks N88-24205
COMPUTER SYSTEMS PROGRAMS
Digital monoplotting, part 1 [B8735122-PT-1] N88-24106
Digital monoplotting, part 2 [B8735122-PT-2] N88-24107
COMPUTER TECHNIQUES
Sensitivity analysis and multidisciplinary optimization for aircraft design: Recent advances and results [NASA-TM-100630] N88-23766
COMPUTER VISION
Conversational Analysis of Color Images (CAICOU): An interactive development system for the analysis of color images [RR-641-I-IMAG-39-LIFIA] N88-23964
Linguistic definition of generic models in computer vision [RSRE-MEMO-4110] N88-24182
Orbital navigation, docking and obstacle avoidance as a form of three dimensional model-based image understanding N88-24194
COMPUTERIZED SIMULATION
Coherent functional development: Key to successful future system integration N88-23803
Numerical method for unsteady viscous-inviscid interaction to calculate buffeting [ONERA-RSF-02/3617-AY-008-A] N88-23949
Simulation: A simulation system in Ada [FOA-A-20043-2.7] N88-24176
Dialog design: General requirements and analysis of an Ada system — user interface design [FOA-C-20691-2.7] N88-24177
A generic multibody simulation [NASA-CR-182949] N88-24198
Parallel discrete-event simulation of FCFS stochastic queueing networks [NASA-CR-181669] N88-24203
Parametric analysis of power requirements for space-based radar N88-24260
ATHENA heat pipe transient model N88-24344
Detailed transient model of a liquid-metal heat pipe N88-24345
SP-100 control system modeling N88-24356
ATHENA simulation of the 300 kW SP-100 N88-24357
EETAP (End-to-End Transient Analysis Program) for space nuclear power system simulation N88-24381
CONCENTRICITY
Fitting a circle to radially suppressed data [NPL-DITC-103/87] N88-24223
CONDENSATES
Method of evaporation [NASA-CASE-NPO-15609-2] N88-23646
CONDENSERS
Dynamic isotope power system critical component verification N88-24421
CONDENSERS (LIQUEFIERS)
Experimental demonstrations of organic Rankine cycle waste heat rejection systems N88-24469
CONDENSING
Transient analysis of heat pipe vapor dynamics N88-24341
Analysis and interpretation of low gravity boiling experiments in the KC-135 N88-24466
CONDUCTIVE HEAT TRANSFER
Three-dimensional curved shell and solid-shell transition finite elements with temperature and temperature gradients as primary variables for steady state heat conduction N88-23997
Mathematical modelling of the heat and water vapour transport in the human respiratory tract N88-24160
Microgravity thaw experiment (MITEX) N88-24439
CONFERENCES
Laminar Flow Aircraft Certification [NASA-CP-2413] N88-23737
The Design, Development and Testing of Complex Avionics Systems [AGARD-CP-417] N88-23767
Structural Ceramics [NASA-CP-2427] N88-23872
Noncontact Temperature Measurement [NASA-CP-2503] N88-23895
Latin American Symposium on Remote Sensing, 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, volume 1 N88-24013
Space Station Human Factors Research Review. Volume 1: EVA Research and Development [NASA-CP-2426-VOL-1] N88-24145
Third Conference on Artificial Intelligence for Space Applications, part 2 [NASA-CP-2492-PT-2] N88-24188
Transactions of the Fifth Symposium on Space Nuclear Power Systems [DE88-006165] N88-24374
Summary report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements — plasma diagnostics [IPPJ-861] N88-24512
CONFIGURATION MANAGEMENT
Reconfigurable work station for a video display unit and keyboard [NASA-CASE-MFS-26009-1-SB] N88-24163
CONTAINMENT
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428
CONTINENTAL SHELVES
Influence of the Yukon River on the Bering Sea [NASA-CR-182802] N88-24126
CONTINUUM MODELING
Continuum modeling and dynamic analysis of large truss structures N88-23995
CONTRACTS
Defense Small Business Innovation Research Program (SBIR). Volume 3: Air Force abstracts of phase 1 awards, 1987 N88-24548
CONTROL RODS
SP-100 system modeling: SNPSAM update N88-24372
CONTROL SIMULATION
A software design tool for the analysis of robot dynamics properties [NLR-MP-86064-4] N88-24171
CONTROL STABILITY
Control law parameterization for an aeroelastic wind-tunnel model equipped with an active roll control system and comparison with experiment [NASA-TM-100593] N88-23807
CONTROL SYSTEMS DESIGN
Investigation of air transportation technology at Princeton University, 1986 N88-23724
Control law parameterization for an aeroelastic wind-tunnel model equipped with an active roll control system and comparison with experiment [NASA-TM-100593] N88-23807
Soviet spacecraft engineering research [FASAC-TAR-3090] N88-23823
Impact of control errors on the volume/weight demand of the Ventilation and Dryer (VAD) concept — EURECA Botany Facility [TN-RB524-006/87] N88-24132
An algorithm for super-optimal H sup inf design: The 2-block case [OUEL-1711/87] N88-24210
A state-space approach to discrete-time super-optimal H sup inf control problems [OUEL-1712/87] N88-24211
Precise computer controlled positioning of robot end effectors using force sensors [NASA-CR-182887] N88-24213

The calculation of casually constrained optima in the active control of sound
[ISVR-TR-147] N88-24237
Safety constraints and considerations in the development of nuclear powered propulsion N88-24276
Two-phase fluid management for a Rankine cycle isotope power system N88-24303
Interaction of the control system with core nuclear design for fast spectrum space power reactors N88-24304
Reactor instrumentation and control design and performance simulation for SP-100 N88-24306
An adaptive load-following control system for a space nuclear power system N88-24307
SP-100 control system modeling N88-24356
Automatic reactor control system for transient operation N88-24493
An optimal disturbance rejection control system for multimegawatt space nuclear power systems N88-24495
SP-100 ground engineering systems test facility control systems N88-24496

CONTROL THEORY
Error control techniques for satellite and space communications
[NASA-CR-182886] N88-23922
Generalized predictive control of multivariable systems
[OUEL-1640/86] N88-24209
Experimental evaluation of the MIT-SNL period-generated minimum time control laws for the rapid adjustment of reactor power N88-24494

CONTROL UNITS (COMPUTERS)
A timing evaluator for C programs generated by the model system
[AD-A191204] N88-24174

CONTROLLED FUSION
Helium-3 fusion fuel resources for space power N88-24330

CONTROLLERS
Reconfigurable work station for a video display unit and keyboard
[NASA-CASE-MFS-26009-1-SB] N88-24163
Connecting remote systems for demonstration of automation technologies N88-24191
Genetic algorithms for adaptive real-time control in space systems N88-24195

CONVECTION CURRENTS
Open cell associated with warm advection N88-24010

CONVECTIVE HEAT TRANSFER
Experimental measurements of heat transfer from an iced surface during artificial and natural cloud icing conditions
[AIAA-PAPER-86-1352] N88-23718
Review of convectively cooled structures for hypersonic flight
[NASA-TM-87740] N88-23817
Single phase liquid immersion cooling of discrete heat sources in a vertical channel
[AD-A191224] N88-23944

CONVERGENCE
Almost sure L(gamma)-norm convergence for data-based histogram density estimates
[AD-A189944] N88-24228
Study of the convergence of a finite difference scheme for acoustic propagation in the atmosphere in a parabolic approximation. Statistical calculation of the sound field in the presence of kinematic turbulence
[ONERA-RS-8/3641-PY-160-P] N88-24235

CONVOLUTION INTEGRALS
Real time pipelined system for forming the sum of products in the processing of video data
[NASA-CASE-NPO-16462-1-CU] N88-24169

COOLANTS
Thermal-hydraulic considerations for particle bed reactors N88-24266
The effect of operating temperature on open, multimegawatt space power systems N88-24352
Fabrication of a niobium 1 percent zirconium containment for SP-100 primary lithium system materials mass transfer studies N88-24373
Reactor core coolability with reduced power levels N88-24425

COOLING
Hydrogen turbines for space power systems: A simplified axial flow gas turbine model N88-24385
Possible creep studies of lithium with a compact device N88-24404
Reactor core coolability with reduced power levels N88-24425
The effect of operating temperature and turbine blade cooling on Brayton cycle space power systems N88-24489
Space power radiation cooled dc transmission line analysis N88-24506

COOLING SYSTEMS
Liquid droplet radiator development N88-24415
The effect of maximum allowable payload temperature on the mass of a multimegawatt space based platform N88-24416
MACRAD: A mass analysis code for radiators N88-24418
Heat pump-augmented systems for spacecraft thermal management N88-24419
Dynamic isotope power system critical component verification N88-24421

COPPER COMPOUNDS
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844

COPPER OXIDES
Comparison between muon spin rotation and neutron scattering studies on the 3-dimensional magnetic ordering of La2CuO(4-y) N88-24244

CORES
Low power consumption current transducer
[NASA-CASE-NPO-16888-1-CU] N88-23937

CORN
Remote sensing techniques in the estimation of the area cultivated with beans, corn, and castor beans in the Irece County (Bahia State) N88-24045
Spectral behavior of crops through analysis of LANDSAT-TM data N88-24047
Evaluation of TM false color composites for crop discrimination N88-24096

CORROSION
Corrosion and fatique properties of FeCrB/Si metallic glass wires in aqueous environments N88-23855
Structural Ceramics
[NASA-CP-2427] N88-23872
Review of alkali metal and refractory alloy compatibility for Rankine cycle applications N88-24447

CORROSION PREVENTION
Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2
[AD-A189660] N88-23847
Corrosion and corrosion inhibition of metals/alloys in methyphosphonic difluoride N88-23850
Development of microencapsulated DNBM quaternary ammonium inhibitors for paints N88-23851
Inadequacies of EMI-seal material: A corrosion study N88-23852
Surface conditioning products as tools for corrosion removal and corrosion prevention N88-23856
The effect of titanium reinforcement on the life of positive grids in lead-acid batteries N88-23857
Recent advances in metallic/ceramic coatings for corrosion control in military applications N88-23858
Carboxylate formation at the interface between a polyimide coating and cobalt N88-23859
Agenda for advancing electrochemical science and technology N88-23861
Vanadic hot corrosion of gas turbine blade coating materials N88-23864
AC impedance analysis of corrosion fatigue in naval aircraft alloys
[AD-A190822] N88-23865

CORROSION RESISTANCE
Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2
[AD-A189660] N88-23847
Polyitaconic acid macromolecule primer for adhesive bonding and corrosion control of aluminum N88-23849
Stress corrosion cracking properties of Al-Li alloys N88-23853
Corrosion of tungsten alloys in marine environments N88-23854
Ion beam alloying of aluminum for corrosion resistance N88-23860

CORTICOSTEROIDS
Evaluation of the endogenous glucocorticoid hypothesis of denervation atrophy
[NASA-CR-182848] N88-24157

COSMOLOGY
Stable, heavy, neutral particles in the sun and in toponium decay N88-24568

COST ANALYSIS
The multi-disciplinary design study: A life cycle cost algorithm
[NASA-CR-4156] N88-24172
Requirements and cost considerations for a combined space nuclear reactor test facility N88-24277

COST REDUCTION
Direct nuclear propulsion for Earth-to-orbit vehicles N88-24271

COUNTING
Coincidence counting corrections under conditions used by A. DeVolpi
[NPL-RS(EXT)90] N88-24224

COUPLING
Control of combustion and acoustically coupled fluid dynamic instabilities N88-23843
Magnetic drive coupling
[NASA-CASE-MSC-21171-1] N88-23973

COVARIANCE
State covariance assignment of discrete systems: Development and applications N88-24225

CRACK PROPAGATION
AC impedance analysis of corrosion fatigue in naval aircraft alloys
[AD-A190822] N88-23865
Fracture mechanics N88-23877
Effect of test sample geometry on the fatigue crack growth of X10NiCrAlTi 32 20 and NiCr22 Co 12Mo
[JUEL-SPEZ-399] N88-23990
Analysis of crack-tip fields in a viscoplastic material N88-23996

CRACK TIPS
Analysis of crack-tip fields in a viscoplastic material N88-23996

CRACKS
Nondestructive Evaluation (NDE) of structural ceramics by photoacoustic microscopy N88-23884
SiC fiber reinforced reaction-bonded Si3N4 composites N88-23892
Weldability of general purpose heat source iridium capsules N88-24429

CRANES
Space spider crane
[NASA-CASE-LAR-13411-1-SB] N88-23828

CREEP PROPERTIES
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites N88-24427

CREW WORKSTATIONS
Crewstation Information and Development System (CIDS) N88-23781

CRITERIA
Systems for the 21st century N88-23769

CRITICAL MASS
Particle bed reactor scaling relationships N88-24267

CROP GROWTH
Estimation of an area cultivated with wheat from LANDSAT data through a two-phase sampling method N88-24041
Remote sensing techniques in the estimation of the area cultivated with beans, corn, and castor beans in the Irece County (Bahia State) N88-24045
CANASATE: Sugar cane mapping by satellite N88-24046
Identification of areas cultivated with soybeans in the cerrados regions, through digital processingof satellite images: A methodological approach N88-24048

CROP IDENTIFICATION
A comparison of supervised maximum likelihood and decision tree classification for crop cover estimation from multitemporal LANDSAT MSS data N88-24014
Spectral behavior of crops through analysis of LANDSAT-TM data N88-24047
Identification of areas cultivated with soybeans in the cerrados regions, through digital processingof satellite images: A methodological approach N88-24048

CROSS FLOW
Crossflow vorticity sensor
[NASA-CASE-LAR-13436-1-CU] N88-23759

CROSS SECTIONS
Total photoionization cross sections of atomic oxygen from threshold to 44.3A
[NASA-CR-182992] N88-24252
The role of integral experiments and nuclear cross section evaluations in space nuclear reactor design N88-24293
Density diagnostics by hydrogen line intensity ratios: Excitation cross section between excited states N88-24522
Distorted-wave-method calculation of electron-impact excitation of atomic ions N88-24532

CRUISING FLIGHT
Inflow measurement made with a laser velocimeter on a helicopter model in forward flight. Volume 5: Tapered planform blades at an advance ratio of 0.23
[NASA-TM-100545] N88-23755

CRYOGENIC COOLING
Review of convectively cooled structures for hypersonic flight
[NASA-TM-87740] N88-23817
Krypton based adsorption type cryogenic refrigerator
[NASA-CASE-NPO-17334-1-CU] N88-23917
Cryogenic regenerator including saran-carbon heat conduction matrix
[NASA-CASE-NPO-17291-1-CU] N88-23946

CRYOGENIC FLUIDS
Nucleate pool boiling: High gravity to reduced gravity; liquid metals to cryogens N88-24464

CRYOGENIC ROCKET PROPELLANTS
Noncryogenic propellants for a nuclear orbit transfer vehicle N88-24444

CRYOGENICS
Gigawatt, closed cycle, vapor core-MHD space power system conceptual design study N88-24473
CRYSTAL DEFECTS
Improved silicon carbide for advanced heat engines N88-23879
Strength optimization of alpha-SiC by improved processing N88-23880
Improved processing of Si3N4 N88-23882
Defects in cubic silicon carbide on silicon N88-24317
CRYSTAL GROWTH
Non-contact temperature measurement requirements for electronic materials processing N88-23898
Method and apparatus for growing crystals [NASA-CASE-MFS-28137-1] N88-24544
Liquid encapsulated float zone process and apparatus [NASA-CASE-MFS-28144-1] N88-24545
CRYSTAL OPTICS
Note on the double crystal method of measuring heat transfer coefficient [OUEL-1710/87] N88-23950
CRYSTAL STRUCTURE
Disclination structures in carbon and graphite [AD-A191056] N88-23868
The structural analysis of some crystalline and semi-crystalline substances using X-ray and neutron diffraction N88-24540
CRYSTALS
Dynamic range compression/expansion of light beams by photorefractive crystals [NASA-CASE-NPO-17140-1-CU] N88-24508
CURING
Cellular thermosetting fluoropolymers and process for making them [NASA-CASE-GSC-13008-1] N88-23894
CURVATURE
Surface curvature and pressure gradient effects on turbulent flow: An assessment based on numerical solution of the Reynolds equations N88-23954
Cylindrical surface profile and diameter measuring tool and method [NASA-CASE-MFS-28287-1] N88-23959
CURVE FITTING
Fitting a circle to radially suppressed data [NPL-DITC-103/87] N88-24223
CYCLIC LOADS
A cyclic ground test of an ion auxiliary propulsion system: Description and operational considerations [NASA-TM-100670] N88-23829
Investigation of the long term effects of aging on carbon epoxy composites exposed naturally to the weather under cyclic loads. (Results of sampling after 2.5 years). Test report M1-641300 [CEAT-39/M/79-C-M1-641300] N88-23834
CYGNUS CONSTELLATION
Colliding stellar winds in the eclipsing Wolf-Rayet binary V444 Cygni [NASA-CR-182937] N88-24563
CYLINDRICAL BODIES
Electromagnetic scattering from nonlinear anisotropic cylinders N88-23930
Cylindrical surface profile and diameter measuring tool and method [NASA-CASE-MFS-28287-1] N88-23959
CZOCHRALSKI METHOD
Real time thermal imaging of high temperature semiconductor melts N88-23914

D

DAMAGE ASSESSMENT
Tornado tracks in Southwestern Brazil, Eastern Paraguay, and Northwestern Argentina N88-24071
DARK MATTER
Stable, heavy, neutral particles in the sun and in toponium decay N88-24568
DATA ACQUISITION
Investigation of air transportation technology at Ohio University, 1986 N88-23719
Modeling of functional specifications for onboard software: Experience with the Rafale avionics system N88-23777
Presentation of the METEOSAT system and the roles of EUMETSAT within the meteorological community N88-24039
ERS-1 data products and services and their value for tropical countries N88-24040
Processing of HRPT data from the NOAA series satellites N88-24053
DATA BASE MANAGEMENT SYSTEMS
Crewstation Information and Development System (CIDS) N88-23781
EnviroNET: An interactive space-environment information resource [NASA-TM-101137] N88-23812
DATA BASES
Operation and performance of an integrated helicopter communication system N88-23787
The SAGE geographic analysis system N88-24063
Implantation of a geo-cartographical information system through microcomputers N88-24064
An irradiation performance data base for nitride fuels N88-24438
DATA CORRELATION
Loran-C monitor correlation over a 92-mile baseline in Ohio N88-23720
DATA FLOW ANALYSIS
Mentat: An object-oriented macro data flow system [NASA-TM-101165] N88-24199
DATA INTEGRATION
Remote sensing and data integration: Practical solutions for resource managers N88-24034
DATA LINKS
Connecting remote systems for demonstration of automation technologies N88-24191
DATA MANAGEMENT
Test philosophy of the EH101 integrated avionic N88-23775
Implantation of a geo-cartographical information system through microcomputers N88-24064
Image management research N88-24150
DATA PROCESSING
VISSR line number monitoring system N88-24008
Some problems with regard to the TOVS processing detected by using NOAA-HRPT data check program N88-24009
Latin American Symposium on Remote Sensing, 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, volume 1 N88-24013
Presentation of the METEOSAT system and the roles of EUMETSAT within the meteorological community N88-24039
Identification of areas cultivated with soybeans in the cerrados regions, through digital processingof satellite images: A methodological approach N88-24048
Digital processing of infrared and visible images from the GOES satellite and its integration with meteorological radar data N88-24057
Thematic mapping utilizing data from the Thematic Mapper sensor of the LANDSAT satellite N88-24060
Parallel binary and parallel coded decimal time code formats [AD-A190126] N88-24170
Unified interchange format for computer data (standard file format) [ESA-STR-225] N88-24183
DATA PROCESSING EQUIPMENT
Real time pipelined system for forming the sum of products in the processing of video data [NASA-CASE-NPO-16462-1-CU] N88-24169
DATA PROCESSING TERMINALS
Presentation of map information on a color display [FOA-C-20687-2.7] N88-24103
DATA SIMULATION
Simulation: A simulation system in Ada [FOA-A-20043-2.7] N88-24176
DATA TRANSFER (COMPUTERS)
Interconnection of high-speed local area networks N88-24205
DATA TRANSMISSION
Investigation of air transportation technology at Ohio University, 1986 N88-23719
Connecting remote systems for demonstration of automation technologies N88-24191
DECISION MAKING
A change in system design emphasis: From machine to man N88-23782
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24026
Remote sensing and data integration: Practical solutions for resource managers N88-24034
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24068
DECISION THEORY
A comparison of supervised maximum likelihood and decision tree classification for crop cover estimation from multitemporal LANDSAT MSS data N88-24014
DEFECTS
Micro-Raman analysis of dielectric optical thin films [AD-A191228] N88-24537
DEFENSE PROGRAM
Free electron lasers in strategic defense [DE88-007024] N88-24231
DEFORMATION
Disclination structures in carbon and graphite [AD-A191056] N88-23868
DEGRADATION
The performance of perfluoropolyalkylether oils under boundary lubrication conditions [AD-A191057] N88-23869
DEIMOS
Power requirements for mining and microwave processing of extraterrestrial resources N88-24389
DELAMINATING
Mechanics of instability-related delimination growth [NASA-TM-100622] N88-23998
DELAY
Estimation of time- and state-dependent delays and other parameters in functional differential equations [NASA-CR-181663] N88-24164
DENSITY MEASUREMENT
Summary report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements — plasma diagnostics [IPPJ-861] N88-24512
Measurements of Z(sub eff) profile with a visible bremsstrahlung continuum detector array N88-24529
DEPTH
Television monitor field shifter and an opto-electronic method for obtaining a stereo image of optimal depth resolution and reduced depth distrotion on a single screen [NASA-CASE-NPO-17249-1-CU] N88-23924
DEPTH MEASUREMENT
In-flight measurement of ice growth on an airfoil using an array of ultrasonic transducers [AIAA-PAPER-87-0178] N88-23717
Mining volume measurement system [NASA-CASE-LAR-13519-1] N88-23963
DESCRIPTIONS
Linguistic definition of generic models in computer vision [RSRE-MEMO-4110] N88-24182
DESIGN ANALYSIS
Full potential methods for analysis/design of complex aerospace configurations [NASA-CR-3982] N88-23736
Sensitivity analysis and multidisciplinary optimization for aircraft design: Recent advances and results [NASA-TM-100630] N88-23766
A structured approach to weapon system design N88-23773
A change in system design emphasis: From machine to man N88-23782
Interfacing and integrating hardware and software design systems N88-23796
A design analysis for an automated robotic workpiece manipulator N88-23975
Assessment of nuclear reactor concepts for low power space applications N88-24409
The Curie point radiator N88-24420
DETECTION
Shape detection in remote sensing through graph isomorphism N88-24028
TES: A modular systems approach to expert system development for real-time space applications N88-24197
Dynamic range compression/expansion of light beams by photorefractive crystals [NASA-CASE-NPO-17140-1-CU] N88-24508
DEUTERIUM
Helium-3 fusion fuel resources for space power N88-24330
DIABETES MELLITUS
Design considerations for the development of an implantable sensor for the continuous measurement of glucose in the diabetic patient N88-24159
DIAMETERS
Cylindrical surface profile and diameter measuring tool and method [NASA-CASE-MFS-28287-1] N88-23959
DICHLORIDES
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125
DIELECTRICS
Low gravity thermal management using dielectrophoretic forces N88-24470
Micro-Raman analysis of dielectric optical thin films [AD-A191228] N88-24537
DIFFERENTIAL EQUATIONS
Estimation of time- and state-dependent delays and other parameters in functional differential equations [NASA-CR-181663] N88-24164
Minimal parameter solution of the orthogonal matrix differential equation [NASA-TM-4043] N88-24165
Existence of periodic solutions in n-dimensional retarded functional differential equations [RR-325] N88-24221

DIFFERENTIAL GEOMETRY
On Hotelling's approach to testing for a nonlinear parameter in regression
[AD-A191189] N88-24229
DIFFUSION
Theory of neutron moisture probes and interpretation of measurements in complex soil and water systems N88-23965
A review of diffusion barrier technology for application in SP-100 fuel pins N88-24328
DIFLUORO COMPOUNDS
Corrosion and corrosion inhibition of metals/alloys in methyphosphonic difluoride N88-23850
DIGITAL COMPUTERS
Interfacing and integrating hardware and software design systems N88-23796
Specification for IBM/IBM compatible 3480 tape cartridge
[NASA-TM-100702] N88-24168
DIGITAL DATA
Textural features for image classification in remote sensing N88-24027
Thematic mapping utilizing data from the Thematic Mapper sensor of the LANDSAT satellite N88-24060
Geometric image correction: An approach for the registration of LANDSAT-TM digital images supported by topographical maps of medium and great scales N88-24061
Visualization of digital terrain models N88-24081
Application of its transformation in color enhancement of LANDSAT imagery N88-24082
Preliminary study on the application of digital processing of TM-LANDSAT data in the mapping of apple orchards in Fraiburgo (SC) N88-24093
DIGITAL FILTERS
Modeling, filtering and control of stochastic processes — communication networks
[ENST-87E021] N88-23925
Spatial filtering on digital images N88-24025
DIGITAL SIMULATION
Simulation and computer aided engineering (the necessity of an integrated approach)
[NLR-MP-86050-U] N88-24178
DIGITAL TECHNIQUES
Clinical applications of computerized thermography N88-23915
Digital processing of infrared and visible images from the GOES satellite and its integration with meteorological radar data N88-24057
Temporal analysis of the changes in Parque Estadual de Jacupiranga vegetation through digital treatment of LANDSAT imagery N88-24094
Evaluation of TM false color composites for crop discrimination N88-24096
DIGITS
Experiments in isolated digit recognition using the multilayer perceptron
[RSRE-MEMO-4073] N88-23927
DIMENSIONS
Three-dimensional models of conventional and vertical junction laser-photovoltaic energy converters
[NASA-TM-4039] N88-24111
DIRECT CURRENT
The LDCM actuator for vibration suppression
[NASA-CR-182896] N88-23940
DIRECT POWER GENERATORS
Direct nuclear propulsion for Earth-to-orbit vehicles N88-24271
Ultra high temperature direct propulsion N88-24275
Safety constraints and considerations in the development of nuclear powered propulsion N88-24276
Nuclear propulsion: Past, present and future N88-24441
Gas core reactors for direct nuclear propulsion N88-24442
DISCRETE FUNCTIONS
Parallel discrete-event simulation of FCFS stochastic queueing networks
[NASA-CR-181669] N88-24203
DISPERSING
Examination of methods for pollen storage and dispersal
[TN-RB524-097/86] N88-24134
DISPLAY DEVICES
Crewstation Information and Development System (CIDS) N88-23781
Presentation of map information on a color display
[FOA-C-20687-2.7] N88-24103
Virtual interface environment N88-24153
DISPOSAL
Nuclear-powered space debris sweeper N88-24380
DISTRIBUTED PROCESSING
TALOS: A distributed architecture for intelligent monitoring and anomaly diagnosis of the Hubble Space Telescope N88-24193
DIVING (UNDERWATER)
Subsea approach to work systems development N88-24146
DOPED CRYSTALS
Improved GaP doped SiGe thermoelectric material N88-24503
DOPPLER EFFECT
Considerations pertinent to the Doppler effect for space reactors N88-24264
DOPPLER RADAR
Doppler radar with multiphase modulation of transmitted and reflected signal
[NASA-CASE-MSC-18808-1] N88-23923
DRAG CHUTES
Unsteady flow about cambered plates
[AD-A191226] N88-23945
DRAG REDUCTION
Study of a system for reducing base drag by controlling vortices
[REPT-87/43] N88-23730
An assessment of the drag reduction properties of riblets and the penalties of off-design conditions
[RAE-TM-AERO-2113] N88-23731
High-flaps for natural laminar flow airfoils N88-23739
Wind tunnel testing of low-drag airfoils N88-23741
Flight experiences with laminar flow N88-23744
Operational considerations for laminar flow aircraft N88-23748
DRAINAGE
Characteristics of drainage determinations in aerial photographs and relief determination on different scales planialtimetric charts for three soils in the state of Sao Paulo N88-24095
Criteria for planimetric and altimetric correction of maps restituted from aerial photographs in 1:100,000 scale N88-24097
DRIFT RATE
Sea ice kinematics: Space and time scales
[AD-A191162] N88-24128
DROP SIZE
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125
DROPS (LIQUIDS)
Method of evaporation
[NASA-CASE-NPO-15609-2] N88-23846
Liquid droplet radiator development N88-24415
The liquid droplet radiator in space: A parametric approach N88-24437
DRYING
Impact of control errors on the volume/weight demand of the Ventilation and Dryer (VAD) concept — EURECA Botany Facility
[TN-RB524-006/87] N88-24132
DUCTED FLOW
Surface curvature and pressure gradient effects on turbulent flow: An assessment based on numerical solution of the Reynolds equations N88-23954
DUNES
Dune fields in central Western Argentina N88-24088
DYNAMIC CHARACTERISTICS
Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness
[NASA-TP-2697] N88-23988
DYNAMIC MODELS
Behavior of a two-layered beam under impact loading
[OUEL-1716/87] N88-23993
DYNAMIC RESPONSE
An adaptive load-following control system for a space nuclear power system N88-24307
DYNAMIC STRUCTURAL ANALYSIS
Unsteady pressure and structural response measurements of an elastic supercritical wing
[NASA-TM-100591] N88-23756
Preliminary 2-D shell analysis of the space shuttle solid rocket boosters
[NASA-TM-100515] N88-23989
Parameter identification methods for improving structural dynamic models
[NASA-TM-100812] N88-23994
Continuum modeling and dynamic analysis of large truss structures N88-23995
Application of integrated fluid-thermal-structural analysis methods
[NASA-TM-100625] N88-24001
Parallel processors and nonlinear structural dynamics algorithms and software
[NASA-CR-182925] N88-24187
DYNAMICAL SYSTEMS
Dynamic range compression/expansion of light beams by photorefractive crystals
[NASA-CASE-NPO-17140-1-CU] N88-24508

E

EARTH (PLANET)
Evaluation of a model of the Earth's gravity field
[EPSHOM-003/87] N88-24116
EARTH IONOSPHERE
Centrifugal acceleration of ions in the polar magnetosphere
[NASA-TM-101148] N88-24120
EARTH MAGNETOSPHERE
Centrifugal acceleration of ions in the polar magnetosphere
[NASA-TM-101148] N88-24120
EARTH MANTLE
The determination of gravity and topography from seismic velocities, accounting for dynamic behavior of the Earth's mantle
[ETN-88-92420] N88-24117
EARTH OBSERVATIONS (FROM SPACE)
International cooperation in remote sensing: The ESA experience N88-24038
EARTH ORBITS
The prediction of satellite lifetimes
[RAE-TR-87030] N88-23818
EARTH RESOURCES
A proposal for a project entitled assessment of forest resources in Uruguay submitted to the United Nations Industrial Development Organization (UNIDO) N88-24016
EARTH SURFACE
A low cost automatic Earth observation satellite tracking ground receiving station N88-23815
The Shuttle Imaging Radar B (SIR-B) experiment report
[NASA-CR-182923] N88-23932
Comparison of the solar radiation estimation method by satellites N88-24055
EARTHNET
International cooperation in remote sensing: The ESA experience N88-24038
EARTHQUAKES
Specific features of emanation, temperature and hydrodynamic fields in the epicentral zone of tectonic earthquake
[DE88-701140] N88-24114
ECLIPSES
Colliding stellar winds in the eclipsing Wolf-Rayet binary V444 Cygni
[NASA-CR-182937] N88-24563
ECONOMIC IMPACT
Evaluation of a flood period (June, 1984) in the southern region of Laguna dos Patos, through remote sensing data, meteorological and oceanographic N88-24083
ECONOMICS
Review of power requirements for satellite remote sensing systems N88-24387
ECOSYSTEMS
The use of SLAR and SIRA imagenes for the classification of forest typen in tropical rain forests N88-24036
Structure and dynamics of vegetation in the middle semi-arid tropics. Quixaba's Caatinga (PE): Terrain analysis of MSS/LANDSAT data N88-24049
Interpretation of MSS/LANDSAT data for evaluation of physical distribution of mangroves in Cananeia-Iguape (SP) N88-24072
EFFLUENTS
Comparison of open and closed multimegawatt space power systems N88-24353
EINSTEIN EQUATIONS
Raychaudhuri equation in the self-consistent Einstein-Cartan theory with spin-density
[NASA-TM-101145] N88-24546
Inflation in Einstein-Cartan theory with energy-momentum tensor with spin
[NASA-TM-101164] N88-24547
ELECTRIC ARCS
Welding torch gas cup extension
[NASA-CASE-MFS-29252-1] N88-23980
ELECTRIC BATTERIES
Energy storage for nuclear burst power systems N88-24431
ELECTRIC CHARGE
Finite element simulation of the atmosphere's electromagnetic response to charge perturbations associated with lightning N88-24124
ELECTRIC CURRENT
Monte Carlo analysis of lateral collection diode arrays
[RSRE-MEMO-4080] N88-23938
ELECTRIC ENERGY STORAGE
Assessment of energy storage concepts for use in sprint power N88-24312
ELECTRIC FIELDS
Low gravity thermal management using dielectrophoretic forces N88-24470

Cascade fluorescences from laser-excited lithium atom for plasma diagnostics N88-24526

ELECTRIC MOTORS
The LDCM actuator for vibration suppression [NASA-CR-182898] N88-23940

ELECTRIC POWER SUPPLIES
High frequency power distribution system [NASA-CR-175071] N88-23939
Arc lamp power supply using a voltage multiplier [NASA-CASE-LAR-13202-1] N88-23942
Magnet shielding analysis for SOAR: A space fusion reactor N88-24269

ELECTRIC PROPULSION
Megawatt level electric propulsion perspectives N88-24294
High power ion thruster performance N88-24295
Electric propulsion options for the SP-100 reference mission N88-24296
Status of high power electric propulsion technology N88-24443

ELECTRIC ROCKET ENGINES
Nuclear electric power for multimegawatt orbit transfer vehicles N88-24261

ELECTRICAL INSULATION
Irradiation test results on thermionic fuel element sheath insulators N88-24280
Research and development of electrical insulators for thermionic applications N88-24449
Ceramic electrical insulator development for thermoelectric SACE power system N88-24459

ELECTRICAL RESISTIVITY
Apparatus for the measurement of resistivity of glasses and ceramics N88-24460

ELECTRIFICATION
Utilization of LANDSAT-TM imagery in the hydroenergetic inventory of the Paraiba de Sul River Basin N88-24077

ELECTRO-OPTICS
Fiber waveguide sensors for intelligent materials [NASA-CR-183028] N88-23968

ELECTROCHEMICAL CELLS
Thermal and power availability transient responses for the Argonne monolithic solid oxide fuel cell N88-24384

ELECTROCHEMICAL CORROSION
Corrosion and corrosion inhibition of metals/alloys in methyphosphonic difluoride N88-23850
Preventing aircraft corrosion by predictive corrosion modeling N88-23863
AC impedance analysis of corrosion fatigue in naval aircraft alloys [AD-A190822] N88-23865

ELECTROCHEMICAL OXIDATION
AC impedance analysis of corrosion fatigue in naval aircraft alloys [AD-A190822] N88-23865

ELECTROCHEMISTRY
Agenda for advancing electrochemical science and technology N88-23861

ELECTRODES
AMTEC electrode development N88-24324
High power density electrodes for AMTEC N88-24501

ELECTROLUMINESCENCE
Study for the determination of general and specific properties of wide energy-band gap HgCdTe in the 1 to 2 micrometer wavelength range [AD-A191091] N88-23934

ELECTROMAGNETIC ABSORPTION
Research investigation directed toward extending the useful range of the electromagnetic spectrum, appendix [AD-A190199] N88-23921

ELECTROMAGNETIC COMPATIBILITY
The electromagnetic threat to future avionic systems N88-23790

ELECTROMAGNETIC FIELDS
Finite element simulation of the atmosphere's electromagnetic response to charge perturbations associated with lightning N88-24124

ELECTROMAGNETIC INTERFERENCE
The electromagnetic threat to future avionic systems N88-23790
Inadequacies of EMI-seal material: A corrosion study N88-23852

ELECTROMAGNETIC NOISE
Research investigation directed toward extending the useful range of the electromagnetic spectrum [AD-A190198] N88-23920
Research investigation directed toward extending the useful range of the electromagnetic spectrum, appendix [AD-A190199] N88-23921

ELECTROMAGNETIC PROPULSION
Electromagnetic powered vehicles (EMPV) for Mars exploration N88-24388
Power and energy requirements for electromagnetic launchers N88-24391

ELECTROMAGNETIC PULSES
The electromagnetic threat to future avionic systems N88-23790

ELECTROMAGNETIC PUMPS
Optimization of SP-100 thermoelectric electromagnetic pump N88-24382

ELECTROMAGNETIC SCATTERING
Electromagnetic scattering from nonlinear anisotropic cylinders N88-23930

ELECTROMAGNETIC SPECTRA
Research investigation directed toward extending the useful range of the electromagnetic spectrum [AD-A190198] N88-23920
Research investigation directed toward extending the useful range of the electromagnetic spectrum, appendix [AD-A190199] N88-23921

ELECTROMAGNETIC WAVE TRANSMISSION
Development of 20 GHz monolithic transmit modules [NASA-CR-182134] N88-24539

ELECTRON DENSITY (CONCENTRATION)
Density diagnostics by hydrogen line intensity ratios: Excitation cross section between excited states N88-24522
Spectral diagnostics for temperature and density measurements on ATF N88-24525
Cascade fluorescences from laser-excited lithium atom for plasma diagnostics N88-24526

ELECTRON DISTRIBUTION
Hot electron diagnostics using X-ray imaging on GAMMA10 N88-24530

ELECTRON ENERGY
Spectral diagnostics for temperature and density measurements on ATF N88-24525
Hot electron diagnostics using X-ray imaging on GAMMA10 N88-24530

ELECTRON PHOTON CASCADES
Cascade fluorescences from laser-excited lithium atom for plasma diagnostics N88-24526

ELECTRON PRECIPITATION
The Jovian aurora: Electron or ion precipitation [NASA-TM-101153] N88-24566

ELECTRON SCATTERING
Distorted-wave-method calculation of electron-impact excitation of atomic ions N88-24532

ELECTRON TRANSFER
Spectroscopic data relevant to alpha particle diagnostics N88-24527

ELECTRON TRANSITIONS
Theoretical studies of solar-pumped lasers [NASA-CR-182929] N88-23971

ELECTRONIC EQUIPMENT
Developing systems using state-of-the-art CAD/CAM technology N88-23795
Single phase liquid immersion cooling of discrete heat sources in a vertical channel [AD-A191224] N88-23944

ELECTRONIC EQUIPMENT TESTS
The response of a power MOSFET (N-channel) and a dielectric isolated operational amplifier to the combined environmental effects of high temperature and total dose gamma radiation N88-24309

ELECTRONIC PACKAGING
Hermetically sealable package for hybrid solid-state electronic devices and the like [NASA-CASE-MSC-20181-1] N88-23941

ELECTRONIC WARFARE
The electromagnetic threat to future avionic systems N88-23790

ELECTRONS
Ion generator and ion application system [NASA-CASE-MFS-28122-1] N88-24253

ELECTROPHORESIS
Moving wall, continuous flow electronphoresis apparatus [NASA-CASE-MFS-28142-1] N88-23845

ELECTROPHYSICS
Air Force ultrafast optical electronics center [AD-A191491] N88-24507

ELEVATION
Mapping from LANDSAT and SPOT satellite imagery N88-24018

ELLIPTICAL GALAXIES
Stochasticity in elliptical galaxies [SER-C-PREPUBL-FASC-20] N88-24556

EMBRITTLEMENT
The role of oxygen on the mechanical behavior of molybdenum alloys N88-24278

EMISSION SPECTRA
Tokamak studies of density sensitive line ratios N88-24521
IUE evidence on the nature of the innermost broad-line region in Seyfert 1 galaxies N88-24552

EMISSIVITY
Direct emissivity measurements on liquids and corrections to multi-color pyrometers N88-23906
Laser pyrometry N88-23910

EMITTANCE
Enhanced emittance of oxidized 304 stainless steel N88-24408

ENCAPSULATING
Development of microencapsulated DNBM quaternary ammonium inhibitors for paints N88-23851
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428
Liquid encapsulated float zone process and apparatus [NASA-CASE-MFS-28144-1] N88-24545

END EFFECTORS
Precise computer controlled positioning of robot end effectors using force sensors [NASA-CR-182867] N88-24213

END-TO-END DATA SYSTEMS
Solid Earth mission end-to-end data system study [C04825.08/FR] N88-23811

ENERGY
Inflation in Einstein-Cartan theory with energy-momentum tensor with spin [NASA-TM-101164] N88-24547

ENERGY CONSERVATION
Three axis attitude control system [NASA-CASE-GSC-12970-1] N88-23808

ENERGY CONVERSION
Rotating-hoop, pulsed-energy converter N88-24433
A multimegawatt space power source radiator design N88-24436
Energy conversion system optimization study for multimegawatt space nuclear power application N88-24492

ENERGY CONVERSION EFFICIENCY
Three-dimensional models of conventional and vertical junction laser-photovoltaic energy converters [NASA-TM-4039] N88-24111
Overview of NASA Lewis Research Center free-piston Stirling engine technology activities applicable to space power systems N88-24255
Benefits of 20 kHz PMAD in a nuclear space station N88-24256
Acoustical gas core reactor with MHD power generation for burst power in a bimodal system N88-24290
A liquid metal MHD concept for multimegawatt space power application N88-24348
Parametric analyses of the TE SP-100 system performance N88-24358
The closed Brayton cycle: An energy conversion system for near-term military space missions N88-24488

ENERGY DISSIPATION
On the magnetic structure and energy balance of EUV-emitting plasma in the quiet Sun N88-24567

ENERGY DISTRIBUTION
An evaluation of energy-independent heavy ion transport coefficient approximations [NASA-TM-101158] N88-24251

ENERGY SOURCES
A proposal for a project entitled assessment of forest resources in Uruguay submitted to the United Nations Industrial Development Organization (UNIDO) N88-24016

ENERGY STORAGE
Aerospace energy systems laboratory: Requirements and design approach [NASA-TM-100423] N88-24206
Energy storage evaluation for burst power applications N88-24430
Energy storage for nuclear burst power systems N88-24431
Value assessment of energy storage concepts in burst power systems N88-24432
Rotating-hoop, pulsed-energy converter N88-24433
Candidate advanced energy storage concepts for multimegawatt burst power systems N88-24434
High power density alkaline fuel cell technology for MMW space burst power N88-24451
Polymer fuel cell as an energy storage component for space power applications N88-24452

ENGINE PARTS
Molten salt corrosion of SiC and Si3N4 N88-23885
Thermal cyclic durability testing of ceramic materials for turbine engines N88-23886
Fractographic and microstructural evaluation of 3500-hour durability specimens N88-23887
Thermal stress minimized, two component, turbine shroud seal [NASA-CASE-LEW-14212-1] N88-23978
Composite piston [NASA-CASE-LAR-13435-1] N88-23981

ENGINE TESTS
SSME technology test bed fast shutdown assessment [NASA-CR-179354] N88-23831
Liquid metal testing at ETEC for the SP-100 program N88-24446

ENGINES
Some design considerations for ceramic components in heat engine applications N88-23875
Nondestructive evaluation of structural ceramics N88-23876
Improved silicon carbide for advanced heat engines N88-23879
Improved silicon nitride for advanced heat engines N88-23881

ENVIRONMENT EFFECTS
Environmental projects. Volume 6: Environmental assessment. New 34-meter antenna at Venus site [NASA-CR-182922] N88-23919
Detection of biomass burning and smoke plumes in the Amazon region through NOAA satellite imagery N88-24085

ENVIRONMENTAL MONITORING
Study of reservoir water quality utilizing remote sensing techniques: Methodological concepts N88-24076

ENVIRONMENTAL SURVEYS
Environmental projects. Volume 6: Environmental assessment. New 34-meter antenna at Venus site [NASA-CR-182922] N88-23919

ENVIRONMENTS
Effects of natural environment on first generation solid rocket booster thermal protection system materials [NASA-TM-100329] N88-24113
The Environment for Application Software Integration and Execution (EASIE) version 1.0. Volume 4: System installation and maintenance guide [NASA-TM-100576] N88-24185
Relating design and environmental variables to reliability N88-24383

EPOXY MATRIX COMPOSITES
Investigation of the long term effects of aging on carbon epoxy composites exposed naturally to the weather under cyclic loads. (Results of sampling after 2.5 years). Test report M1-641300 [CEAT-39/M/79-C-M1-641300] N88-23834

EQUATIONS OF STATE
Quark core stars, quark stars and strange stars [DE88-006991] N88-24555

EQUILIBRIUM EQUATIONS
A thermal equilibrium model for multi-megawatt space platforms N88-24332

EQUIPMENT SPECIFICATIONS
Processing of HRPT data from the NOAA series satellites N88-24053
High power density electrodes for AMTEC N88-24501

ERROR ANALYSIS
Note on the double crystal method of measuring heat transfer coefficient [OUEL-1710/87] N88-23950
Adjusting a finite element model using vibration type experimental data. Concept and error detection [ONERA-RT-7/3313-RY-060-R] N88-24220
A recursive prediction error parameter estimator for nonlinear models [RR-326] N88-24222

ERROR CORRECTING DEVICES
A control technique for improved robot performance N88-24212

ERROR DETECTION CODES
Automatically generated acceptance test: A software reliability experiment [NASA-CR-181667] N88-23984

ERRORS
Error control techniques for satellite and space communications [NASA-CR-182886] N88-23922
Theory of neutron moisture probes and interpretation of measurements in complex soil and water systems N88-23965
The modeling of error budget analysis and tolerance specifications for BRESEX multiband linear array CCD camera N88-24029
Digital processing of infrared and visible images from the GOES satellite and its integration with meteorological radar data N88-24057
Geometric image correction: An approach for the registration of LANDSAT-TM digital images supported by topographical maps of medium and great scales N88-24061
Study of methods of post-processing applied to a problem of standard classification N88-24067
Fault diagnosis in orbital refueling operations N88-24154
Coincidence counting corrections under conditions used by A. DeVolpi [NPL-RS(EXT)90] N88-24224
Angular position measurements at high temperatures and high radiation environments N88-24479

ERS-1 (ESA SATELLITE)
ERS-1 data products and services and their value for tropical countries N88-24040

ESTIMATES
Parameter estimation for boundary value problems by integral equations of the second kind [NASA-CR-181660] N88-23918
Comparison of the solar radiation estimation method by satellites N88-24055
Digital processing of infrared and visible images from the GOES satellite and its integration with meteorological radar data N88-24057
Improved estimators in simultaneous estimation of scale parameters [AD-A191108] N88-24216

ESTIMATING
Improved estimators in simultaneous estimation of scale parameters [AD-A191108] N88-24216
RSMASS: A simple model for estimating reactor/shield masses N88-24355

ETCHING
Microelectronics the next fifteen years N88-23792

ETHERS
The performance of perfluoropolyalkylether oils under boundary lubrication conditions [AD-A191057] N88-23869

EURECA (ESA)
Botany Facility pre-phase C/D. Core payload for EURECA, volume 2 [BF-RP-ER-015-VOL-2] N88-24130
Life Support Subsystem (LSS). Concept for the Botany Facility --- EURECA [TN-RB524-107/86] N88-24131
Impact of control errors on the volume/weight demand of the Ventilation and Dryer (VAD) concept --- EURECA Botany Facility [TN-RB524-006/87] N88-24132
Summary of the activities performed during the Botany Facility (BF) predevelopment phase for the Life Support S/S (LSS) [TB-RB524-002/87] N88-24133
Examination of methods for pollen storage and dispersal [TN-RB524-097/86] N88-24134
Botany Facility. Thermal Control (TC) subsystem test report on experiment container of laboratory model and breadboard centrifuge [BF-TN-ER-061/86] N88-24135
Botany Facility: Test report on breadboard tests for the determination of the heat transfer at the glass disk and of the temperature distribution in the fluorescent tube [BF-TN-ER-053] N88-24136
Botany Facility: Breadboarding results of the illumination system [SIRA-A/7373/WP110/MAC003] N88-24137
Botany Facility: Magnetic fluid seal considerations for the centrifuge [SIRA-A/7373/WP110/MAC004] N88-24138
Botany Facility: Considerations and analyses of the balancing system philosophy proposed for the BF centrifuge [SIRA-A/7373/WP110/PWF001] N88-24139
Botany Facility: The problems of plant fixation [SIRA-A/7373/WP220/RJS/001] N88-24140
Botany Facility: Problems of water supply, plant nutrients and soil in the Botany Facility [SIRA-A/7373/WP220/RJS/003] N88-24141
Supply and distribution of plant nutrients in the Botany Facility [SIRA-A/7373/WP220/RJS/004] N88-24142
EURECA Botany Facility. Technical note: Removal of phytotoxins [SIRA-A/7373/WP220/RJS/005] N88-24143
Botany Facility pre-phase C/D. Core payload for EURECA, volume 1 [BF-RP-ER-015-VOL-1] N88-24144

EUROPEAN SPACE AGENCY
Preparing for the new programs. The ESA technological research and development program 1988-1990 [ESA-SP-1095] N88-23814
International cooperation in remote sensing: The ESA experience N88-24038

EUROPEAN SPACE PROGRAMS
Preparing for the new programs. The ESA technological research and development program 1988-1990 [ESA-SP-1095] N88-23814
Colombus feasibility studies, executive summary [ETN-88-92334] N88-23820
Insert design handbook [ESA-PSS-03-1202-ISSUE-1] N88-23822
International cooperation in remote sensing: The ESA experience N88-24038
The high-throughput X-ray spectroscopy mission E6889478 MN513835 --- ESA program [ESA-SP-1092] N88-24554

EVALUATION
Evaluation of the endogenous glucocorticoid hypothesis of denervation atrophy [NASA-CR-182848] N88-24157

EVANESCENCE
Monolithic integration on a GaAs substrate of a quarter ring laser and an optical guide coupled by an evanescent wave [ETN-88-92308] N88-23969

EVAPORATION
Method of evaporation [NASA-CASE-NPO-15609-2] N88-23846
Transient analysis of heat pipe vapor dynamics N88-24341

EXCIMER LASERS
Realization of an XeCl laser producing 100W on average [ETN-88-92541] N88-23970

EXCITATION
Saturation and the limit of jet mixing enhancement by single frequency plane wave excitation: Experiment and theory [NASA-TM-100882] N88-23732
Search for bound states of the eta-meson in light nuclei N88-24248

EXOBIOLOGY
Botany Facility pre-phase C/D. Core payload for EURECA, volume 1 [BF-RP-ER-015-VOL-1] N88-24144
USSR Space Life Sciences Digest, Issue 17 [NASA-CR-3922(20)] N88-24155
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 311) [NASA-SP-7011(311)] N88-24161

EXPANSION
Dynamic range compression/expansion of light beams by photorefractive crystals [NASA-CASE-NPO-17140-1-CU] N88-24508

EXPERIMENTATION
On-orbit technology experiment facility definition [NASA-TM-100614] N88-23824

EXPERT SYSTEMS
Architecture and role of the Sensor Subsystem in future aircraft weapon systems N88-23770
Rapid prototyping of complex avionic system architectures N88-23771
Psychosensory cockpit ergonomics, advantages of intelligent information systems N88-23784
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24026
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24068
Fault diagnosis in orbital refueling operations N88-24154
Third Conference on Artificial Intelligence for Space Applications, part 2 [NASA-CP-2492-PT-2] N88-24188
Integration of symbolic and algorithmic hardware and software for the automation of space station subsystems N88-24190
Connecting remote systems for demonstration of automation technologies N88-24191
Knowledge based system verification and validation as related to automation of space station subsystems: Rationale for a knowledge based system lifecycle N88-24192
TALOS: A distributed architecture for intelligent monitoring and anomaly diagnosis of the Hubble Space Telescope N88-24193
Genetic algorithms for adaptive real-time control in space systems N88-24195
TES: A modular systems approach to expert system development for real-time space applications N88-24197
Expert systems approach to modeling systems with the ATHENA thermal-hydraulics code N88-24365

EXTINCTION
SAGE 1 and SAM 2 measurements of 1 micron aerosol extinction in the free troposphere [NASA-CR-182945] N88-24121

EXTRATERRESTRIAL RADIATION
Space nuclear reactor shielding optimization studies N88-24320

EXTRAVEHICULAR ACTIVITY
An investigation of conformable antennas for the astronaut backpack communication system [NASA-CR-182908] N88-23929
Space Station Human Factors Research Review. Volume 1: EVA Research and Development [NASA-CP-2426-VOL-1] N88-24145
Advanced EVA system design requirements study N88-24147
Nuclear electric power for multimegawatt orbit transfer vehicles N88-24251

F

F-15 AIRCRAFT
Augmentor performance of an F100 engine model derivative engine in an F-15 airplane
[NASA-TM-86745] N88-23805
F-106 AIRCRAFT
Sensitivity of F-106B leading-edge-vortex images to flight and vapor-screen parameters
[NASA-TP-2818] N88-23760
FABRICATION
Study for the determination of general and specific properties of wide energy-band gap HgCdTe in the 1 to 2 micrometer wavelength range
[AD-A191091] N88-23934
Miniature traveling wave tube and method of making
[NASA-CASE-LEW-14520-1] N88-23936
Fabrication of SP-100 fuel barrier structures by chemical vapor deposition N88-24371
Molybdenum-base cermet fuel development N88-24481
FABRICS
A reflux tube fabric radiator N88-24394
Fabric radiators N88-24435
Development of materials for fabric radiators N88-24448
FAILURE ANALYSIS
Local buckling and crippling of composite stiffener sections
[NASA-TM-101133] N88-23840
FAILURE MODES
Some design considerations for ceramic components in heat engine applications N88-23875
Evaluation of UN fuel pin failure modes and motion of fuel during severe accidents for reactors in space N88-24424
Fatigue failure of regenerator screens in a high frequency Stirling engine N88-24491
FAINT OBJECTS
Survival analysis, or what to do with upper limits in astronomical surveys
[NASA-CR-182936] N88-24551
FAR INFRARED RADIATION
Balloon-borne three-meter telescope for far-infrared and submillimeter astronomy
[NASA-CR-182924] N88-24550
FARADAY EFFECT
Studies for the definition of a Faraday converter for space nuclear systems N88-24339
FAST FOURIER TRANSFORMATIONS
Spatial filtering on digital images N88-24025
FAST NEUTRONS
Neutron radiation tolerance of Au-activated silicon N88-24316
FAST NUCLEAR REACTORS
The results of application studies for space nuclear power N88-24259
BIFOLD: A dual-mode nuclear space power system N88-24292
Interaction of the control system with core nuclear design for fast spectrum space power reactors N88-24304
A dynamic model for the aft accumulator in the TE SP-100 system N88-24354
Parametric analyses of the TE SP-100 system performance N88-24358
FATIGUE (MATERIALS)
Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2
[AD-A189660] N88-23847
Corrosion and fatique properties of FeCrB/Si metallic glass wires in aqueous environments N88-23855
Effect of test sample geometry on the fatigue crack growth of X10NiCrAlTi 32 20 and NiCr22 Co 12Mo
[JUEL-SPEZ-399] N88-23990
Fatigue failure of regenerator screens in a high frequency Stirling engine N88-24491
FAULT TOLERANCE
Rule-based fault-tolerant flight control N88-23725
Development of a generic architecture N88-23774
FEASIBILITY ANALYSIS
Colombus feasibility studies, executive summary
[ETN-88-92334] N88-23820
Automatically generated acceptance test: A software reliability experiment
[NASA-CR-181667] N88-23984
Assessment of nuclear reactor concepts for low power space applications N88-24409
Heat pump-augmented systems for spacecraft thermal management N88-24419
Molybdenum-base cermet fuel development N88-24481
TRICE design, evaluation and feasibility tests N88-24498
FEEDBACK CONTROL
Investigation of air transportation technology at Princeton University, 1986 N88-23724
Control of combustion and acoustically coupled fluid dynamic instabilities N88-23843
Precise computer controlled positioning of robot end effectors using force sensors
[NASA-CR-182867] N88-24213
Experimental evaluation of the MIT-SNL period-generated minimum time control laws for the rapid adjustment of reactor power N88-24494
An optimal disturbance rejection control system for multimegawatt space nuclear power systems N88-24495
FERROMAGNETIC MATERIALS
The Curie point radiator N88-24420
FIBER COMPOSITES
Ceramics for turbine engines N88-23873
Ceramic matrix composites N88-23888
Polymer precursors for ceramic composites N88-23890
SiC fiber reinforced reaction-bonded Si3N4 composites N88-23892
Input-output characterization of fiber composites by SH waves
[NASA-CR-4153] N88-23986
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites N88-24427
FIBER OPTICS
The role of fiberoptics in remote temperature measurement N88-23909
Fiber waveguide sensors for intelligent materials
[NASA-CR-183028] N88-23968
FIBERS
Polymer precursors for SiC ceramic materials N88-23889
FIELD EFFECT TRANSISTORS
The response of a power MOSFET (N-channel) and a dielectric isolated operational amplifier to the combined environmental effects of high temperature and total dose gamma radiation N88-24309
Modeling of radiation dose dependence of MOSFETs N88-24370
The response of selected semiconductor technologies to the combined environmental effects of high temperature and total dose gamma radiation N88-24462
Development of 20 GHz monolithic transmit modules
[NASA-CR-182134] N88-24539
FIELD THEORY (ALGEBRA)
An introduction to poloidal and toroidal fields
[MITT-54] N88-24232
FIGHTER AIRCRAFT
PAN AIR analysis of the NASA/MCAIR 279-3: An advanced supersonic V/STOL fighter/attack aircraft
[NASA-TM-86838] N88-23750
FIGURE OF MERIT
Preparation of improved PbSnTe thermoelectric alloys and evaluation of their figure of merit
[AD-A191346] N88-24538
FILE MAINTENANCE (COMPUTERS)
Unified interchange format for computer data (standard file format)
[ESA-STR-225] N88-24183
FINITE DIFFERENCE THEORY
Study of the convergence of a finite difference scheme for acoustic propagation in the atmosphere in a parabolic approximation. Statistical calculation of the sound field in the presence of kinematic turbulence
[ONERA-RS-8/3641-PY-160-P] N88-24235
FINITE ELEMENT METHOD
Three-dimensional curved shell and solid-shell transition finite elements with temperature and temperature gradients as primary variables for steady state heat conduction N88-23997
The Shock and Vibration Digest, volume 20, no. 4 N88-24214
State-of-the-art in true space-time finite element method N88-24215
Adjusting a finite element model using vibration type experimental data. Concept and error detection
[ONERA-RT-7/3313-RY-060-R] N88-24220
FIRE DAMAGE
Evaluation of a burned area and the vegetation regeneration affected by the burning in the Parque Nacional de Brazilia through TM/LANDSAT data N88-24073
FIRES
Detection of biomass burning and smoke plumes in the Amazon region through NOAA satellite imagery N88-24085
FISSION ELECTRIC CELLS
Noncryogenic propellants for a nuclear orbit transfer vehicle N88-24444
FISSION PRODUCTS
Analysis of a nuclear orbital transfer vehicle reentry accident N88-24426
FIXING
Botany Facility: The problems of plant fixation
[SIRA-A/7373/WP220/RJS/001] N88-24140
FLAME STABILITY
The structure and stability of spherically expanding flames N88-23842
FLAPPING
Propulsive performance of a lifting flapping wing N88-23733
FLAPS (CONTROL SURFACES)
Operational considerations for laminar flow aircraft N88-23748
FLAVOR (PARTICLE PHYSICS)
Quark core stars, quark stars and strange stars
[DE88-006991] N88-24555
FLEXIBILITY
Vibration and control of flexible rotor supported by magnetic bearings
[NASA-TM-100888] N88-23977
FLIGHT CHARACTERISTICS
Certification aspects of airplanes which may operate with significant natural laminar flow N88-23749
FLIGHT CONTROL
Integrated avionics reliability N88-23723
Investigation of air transportation technology at Princeton University, 1986 N88-23724
Rule-based fault-tolerant flight control N88-23725
A comparison of integrated and separate systems for flight control and navigation N88-23779
Software engineering for the British Aerospace Experimental Aircraft Programme (EAP) N88-23798
Development of an airborne facility for advanced avionics research N88-23801
FLIGHT ENVELOPES
Flight testing a V/STOL aircraft to identify a full-envelope aerodynamic model
[NASA-TM-100996] N88-23762
FLIGHT PATHS
Flight penetration of wind shear: Control strategies N88-23727
FLIGHT SAFETY
UK airmiss statistics
[CAA-1/87] N88-23761
FLIGHT SIMULATORS
A look toward the future of complex avionics systems development using the USAF Test Pilot School's avionics systems test training aircraft N88-23797
Digital monoplotting, part 1
[B8735122-PT-1] N88-24106
Digital monoplotting, part 2
[B8735122-PT-2] N88-24107
FLIGHT TESTS
Boundary layer flow visualization for flight testing N88-23742
Flight experiences with laminar flow N88-23744
Operational considerations for laminar flow aircraft N88-23748
Flight testing a V/STOL aircraft to identify a full-envelope aerodynamic model
[NASA-TM-100996] N88-23762
The integration, characterisation and trialling of a modern complex airborne radar N88-23791
FLOAT ZONES
Liquid encapsulated float zone process and apparatus
[NASA-CASE-MFS-28144-1] N88-24545
FLOATING POINT ARITHMETIC
Scientific computing environments
[AD-A191239] N88-24175
MIPS: The good, the bad and the useful
[NASA-CR-182893] N88-24184
FLOOD PLAINS
Geomorphologic sector maps of Niquizanga-Mayares, province of San Juan, Argentina N88-24098
FLOODS
Evaluation of the floodable area of the canal of Sao Goncalo through TM-LANDSAT 5 imagery N88-24078
Evaluation of a flood period (June, 1984) in the southern region of Laguna dos Patos, through remote sensing data, meteorological and oceanographic N88-24083
Mapping of plant associations and the variation of surface water in the Pantanal Mato-Grossense National Park, through remote sensing techniques N88-24092
FLORIDA
Critical nuclear launch issues: A perspective from the State of Florida N88-24412
FLOW CHAMBERS
Moving wall, continuous flow electronphoresis apparatus
[NASA-CASE-MFS-28142-1] N88-23845
FLOW DISTORTION
Moving wall, continuous flow electronphoresis apparatus
[NASA-CASE-MFS-28142-1] N88-23845

FLOW DISTRIBUTION
A numerical study of the hot gas environment around a STOVL aircraft in ground proximity [NASA-TM-100895] N88-23729
Unsteady flow about cambered plates [AD-A191226] N88-23945
Indentification of shallow groundwater regions in semi-arid Brazil by remote sensing methods N88-24030
Theoretical and experimental investigation of swirl flow phase separators for microgravity applications N88-24335
A compressible vapor flux model for transient heat pipe analysis N88-24343
ATHENA simulation of the 300 kW SP-100 N88-24357
Theoretical prediction of single phase turbulent flow distribution in particulate bed reactors N88-24386
Microgravity two-phase fluid flow pattern modeling N88-24467

FLOW EQUATIONS
Modeling of cavitation phenomena in homogeneous flow in transitory regimes in pipes [ISAL-IDI1-87-15] N88-23948

FLOW MEASUREMENT
Crossflow vorticity sensor [NASA-CASE-LAR-13436-1-CU] N88-23759

FLOW REGULATORS
Moving wall, continuous flow electronphoresis apparatus [NASA-CASE-MFS-28142-1] N88-23845

FLOW STABILITY
Control of combustion and acoustically coupled fluid dynamic instabilities N88-23843

FLOW VELOCITY
Evaluation of a flood period (June, 1984) in the southern region of Laguna dos Patos, through remote sensing data, meteorological and oceanographic N88-24083

FLOW VISUALIZATION
Study of a system for reducing base drag by controlling vortices [REPT-87/43] N88-23730
Boundary layer flow visualization for flight testing N88-23742
Acoustically excited heated jets. 1: Internal excitation [NASA-CR-4129-PT-1] N88-23751
Acoustically excited heated jets. 2: In search of a better understanding [NASA-CR-4129-PT-2] N88-23752
Acoustically excited heated jets. 3: Mean flow data [NASA-CR-4129-PT-3] N88-23753
Single phase liquid immersion cooling of discrete heat sources in a vertical channel [AD-A191224] N88-23944
Dual wavelength holographic interferometry system [NASA-CASE-MFS-28242-1] N88-23960

FLOWMETERS
Crossflow vorticity sensor [NASA-CASE-LAR-13436-1-CU] N88-23759

FLUID DYNAMICS
Control of combustion and acoustically coupled fluid dynamic instabilities N88-23843
Noncontact temperature measurements in the microgravity fluids and transport phenomena discipline N88-23901
Fluid dynamics of spherical cavity reactors N88-24291

FLUID FLOW
Numerical modelling of flows using phoenics N88-23955
Dual wavelength holographic interferometry system [NASA-CASE-MFS-28242-1] N88-23960
Pressure measuring probe [NASA-CASE-LAR-13853-1] N88-23961

FLUID MANAGEMENT
Two-phase fluid management for a Rankine cycle isotope power system N88-24303
Turbomachinery in space N88-24321

FLUORESCENCE
Cascade fluorescences from laser-excited lithium atom for plasma diagnostics N88-24526
Flux density measurements of neutral iron in TEXTOR with laser induced fluorescence N88-24528

FLUOROPOLYMERS
Cellular thermosetting fluoropolymers and process for making them [NASA-CASE-GSC-13008-1] N88-23894

FLUX (RATE)
Johnson noise thermometer for high-radiation and high-temperature environments N88-24480

FLUX DENSITY
Flux density measurements of neutral iron in TEXTOR with laser induced fluorescence N88-24528

FLUX PINNING
Generation of flux tube waves in stellar convection zones. 1: Longitudinal tube waves [NASA-TM-101152] N88-24561

FLY BY WIRE CONTROL
Integrated Application of Active Controls (IAAC) technology to an advanced subsonic transport project: Program review [NASA-CR-3880] N88-23763

FLYWHEELS
Three axis attitude control system [NASA-CASE-GSC-12970-1] N88-23808
Assessment of energy storage concepts for use in sprint power N88-24312
Nuclear Rankine/flywheel MMW space power concept N88-24349
Energy storage for nuclear burst power systems N88-24431
Value assessment of energy storage concepts in burst power systems N88-24432
Rotating-hoop, pulsed-energy converter N88-24433
Candidate advanced energy storage concepts for multimegawatt burst power systems N88-24434

FOAMS
Cellular thermosetting fluoropolymers and process for making them [NASA-CASE-GSC-13008-1] N88-23894

FOIL BEARINGS
Foil gas bearing system endurance testing dynamic isotope power system N88-24302

FORBIDDEN TRANSITIONS
Forbidden transitions as ion-temperature sensitive lines N88-24520

FOREBODIES
Wind-tunnel investigation of actuated forebody strakes for yaw control at high angles of attack N88-23754

FORECASTING
Specific features of emanation, temperature and hydrodynamic fields in the epicentral zone of tectonic earthquake [DE88-701140] N88-24114
An investigation of Soviet capabilities in extended range arctic ice forecasting [AD-A191082] N88-24127

FOREST FIRES
Evaluation of a burned area and the vegetation regeneration affected by the burning in the Parque Nacional de Brazilia through TM/LANDSAT data N88-24073

FOREST MANAGEMENT
Utilization of TM/LANDSAT images in the implanted forests mapping in the Mogi-Guacu Region (SP-Brazil) N88-24042

FORESTS
Radar penetration in the Amazonian rain forest N88-24015
A proposal for a project entitled assessment of forest resources in Uruguay submitted to the United Nations Industrial Development Organization (UNIDO) N88-24016
Airborne and spaceborne radar images for geologic and environmental mapping in the Amazon rain forest, Brazil N88-24021
The use of SLAR and SIRA imagenes for the classification of forest typen in tropical rain forests N88-24036
Utilization of TM/LANDSAT images in the implanted forests mapping in the Mogi-Guacu Region (SP-Brazil) N88-24042
Anomalies in the vegetation in the Alto Xingu - MT N88-24043
Radar penetration in the Amazonian rain forest N88-24044
Stereoscopic photographs, ground and aerial, of trees used in the arborization of Curitiba (PR) N88-24091
Mapping of plant associations and the variation of surface water in the Pantanal Mato-Grossense National Park, through remote sensing techniques N88-24092

FORGING
Brief evaluation of the alloy 17-4-PH (Z5 CNU 17-04). Semifinished product: 205 mm dia forged roller, test reports [DF/NH-3616/84] N88-23866

FORMALISM
Spatial filtering on digital images N88-24025

FORMAT
Parallel binary and parallel coded decimal time code formats [AD-A190126] N88-24170
Unified interchange format for computer data (standard file format) [ESA-STR-225] N88-24183
A five-layer Open Systems Interconnection (OSI) implementation N88-24204

FOSSILS
Disclination structures in carbon and graphite [AD-A191056] N88-23868

FRACTOGRAPHY
Fractographic and microstructural evaluation of 3500-hour durability specimens N88-23887

FRACTURE MECHANICS
Strain intensity factor approach for predicting the strength of continuously reinforced metal matrix composites [NASA-TM-100617] N88-23836
Structural Ceramics [NASA-CP-2427] N88-23872
Friction and wear of ceramics N88-23874
Some design considerations for ceramic components in heat engine applications N88-23875
Nondestructive evaluation of structural ceramics N88-23876
Fracture mechanics N88-23877
Structural ceramics research N88-23878
Effect of test sample geometry on the fatigue crack growth of X10NiCrAlTi 32 20 and NiCr22 Co 12Mo [JUEL-SPEZ-399] N88-23990
Mechanics of instability-related delimination growth [NASA-TM-100622] N88-23998

FRACTURE STRENGTH
Ceramic matrix composites N88-23888
Polymer precursors for ceramic composites N88-23890

FREE ATMOSPHERE
SAGE 1 and SAM 2 measurements of 1 micron aerosol extinction in the free troposphere [NASA-CR-182945] N88-24121

FREE ELECTRON LASERS
Free electron lasers in strategic defense [DE88-007024] N88-24231

FREE-PISTON ENGINES
Overview of NASA Lewis Research Center free-piston Stirling engine technology activities applicable to space power systems N88-24255

FREQUENCY DISCRIMINATORS
Acoustic emission frequency discrimination [NASA-CASE-MSC-20467-1] N88-23966

FRICTION
Friction and wear of ceramics N88-23874

FRICTION DRAG
An assessment of the drag reduction properties of riblets and the penalties of off-design conditions [RAE-TM-AERO-2113] N88-23731

FRICTION MEASUREMENT
Boundary layer measurements using hot-film sensors N88-23743

FRONTS (METEOROLOGY)
Observations of frontal instabilities on an upwelling filament [AD-A191051] N88-24122

FRUITS
Preliminary study on the application of digital processing of TM-LANDSAT data in the mapping of apple orchards in Fraiburgo (SC) N88-24093

FUEL CAPSULES
Weldability of general purpose heat source iridium capsules N88-24429

FUEL CELLS
Monolithic fuel cell based power source for sprint power generation N88-24313
Thermal and power availability transient responses for the Argonne monolithic solid oxide fuel cell N88-24384
Energy storage for nuclear burst power systems N88-24431
Value assessment of energy storage concepts in burst power systems N88-24432
Polymer fuel cell as an energy storage component for space power applications N88-24452

FUEL CORROSION
Molten salt corrosion of SiC and Si3N4 N88-23885
Development of reliable fuel pins for space reactor applications N88-24326

FUEL FLOW
Arcjet thruster research and technology, phase 1 [NASA-CR-182107] N88-23830

FUEL SYSTEMS
An irradiation performance data base for nitride fuels N88-24436

FUEL TANKS
Fuel containment, lightning protection and damage tolerance in large composite primary aircraft structures [NASA-CR-3875] N88-23839

FUNCTIONAL DESIGN SPECIFICATIONS
Critical issues for SOAR: The space orbiting advanced fusion power reactor N88-24474
Low cross-section Mo-Nb thermocouples for nuclear application: The state-of-the-art N88-24477

FUNCTIONS (MATHEMATICS)
Estimation of time- and state-dependent delays and other parameters in functional differential equations
[NASA-CR-181663] N88-24164
FUSELAGES
Multi-body aircraft with an all-movable center fuselage actively controlling fuselage pressure drag
[NASA-CASE-LAR-13511-1] N88-23765
Helicopter anti-torque system using fuselage strakes
[NASA-CASE-LAR-13630-1] N88-23809
FUSION REACTORS
Magnet shielding analysis for SOAR: A space fusion reactor N88-24269
A fusion based plasma propulsion system N88-24274
SOAR: Space orbiting advanced fusion power reactor N88-24366
Energy requirements for HE-3 mining operations on the Moon N88-24390

G

GALACTIC COSMIC RAYS
A benchmark for galactic cosmic ray transport codes
[NASA-TM-101157] N88-24571
GALACTIC NUCLEI
IUE evidence on the nature of the innermost broad-line region in Seyfert 1 galaxies N88-24552
GALACTIC STRUCTURE
Differential spectral synthesis of the stellar populations in the bulges of spiral galaxies N88-24558
GALLIUM ARSENIDES
Monolithic integration on a GaAs substrate of a quarter ring laser and an optical guide coupled by an evanescent wave
[ETN-88-92308] N88-23969
GALLIUM PHOSPHIDES
Improved GaP doped SiGe thermoelectric material N88-24503
GAMMA RAY ASTRONOMY
Spectral modelling of the soft gamma ray repeater
[DE88-007027] N88-24570
GAMMA RAY BURSTS
Spectral modelling of the soft gamma ray repeater
[DE88-007027] N88-24570
GAMMA RAY SPECTRA
Spectral modelling of the soft gamma ray repeater
[DE88-007027] N88-24570
GAMMA RAY SPECTROMETERS
The gamma-ray spectrometer experiment on the solar maximum mission satellite
[NASA-CR-182977] N88-24569
GAMMA RAYS
The response of a power MOSFET (N-channel) and a dielectric isolated operational amplifier to the combined environmental effects of high temperature and total dose gamma radiation N88-24309
MMW shielding design and analysis N88-24457
The response of selected semiconductor technologies to the combined environmental effects of high temperature and total dose gamma radiation N88-24462
GAS BEARINGS
Foil gas bearing system endurance testing dynamic isotope power system N88-24302
Dynamic isotope power system critical component verification N88-24421
GAS COMPOSITION
Requirements for temperature and species concentration measurements in microgravity combustion experiments N88-23903
Laser Diagnostics for combustion temperature and species measurements N88-23912
GAS COOLED REACTORS
A critique of NERVA based nuclear reactor design and performance for MMW space propulsion applications N88-24297
Gas-cooled reactor power systems for space N88-24350
Inherently safe space reactors N88-24363
Multimegawatt nuclear power system for lunar base applications N88-24367
Gas core reactors for direct nuclear propulsion N88-24442
Transient analyses of multimegawatt space reactors N88-24456
The NERVA derivative reactor and a systematic approach to multiple space power requirements N88-24458
Burst power gas core reactor with MHD power generation N88-24472
GAS DYNAMICS
Transient analysis of heat pipe vapor dynamics N88-24341
Heat pipe transient analysis: Vapor dynamics N88-24397
GAS GENERATORS
Preliminary analysis of helium generation and its effects on the SP-100 system performance N88-24406
GAS LASERS
Neutronics conceptual design of a UF6-fueled gaseous laser system N88-24405
GAS TRANSPORT
Preliminary study of niobium alloy contamination by transport through helium N88-24279
GAS TURBINE ENGINES
Thermal stress minimized, two component, turbine shroud seal
[NASA-CASE-LEW-14212-1] N88-23978
GAS TURBINES
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Part 4: Aerodynamic data tabulation
[NASA-CR-179469] N88-23956
Hydrogen turbines for space power systems: A simplified axial flow gas turbine model N88-24385
GAS-LIQUID INTERACTIONS
Microgravity two-phase fluid flow pattern modeling N88-24467
GASEOUS FISSION REACTORS
Acoustical gas core reactor with MHD power generation for burst power in a bimodal system N88-24290
GELS
Cellular thermosetting fluoropolymers and process for making them
[NASA-CASE-GSC-13008-1] N88-23894
GENERAL AVIATION AIRCRAFT
It's time to reinvent the general aviation airplane N88-23726
High-flaps for natural laminar flow airfoils N88-23739
Certification aspects of airplanes which may operate with significant natural laminar flow N88-23749
GENETIC ENGINEERING
Saccharification of cellulose by combined fungal and bacterial preparations N88-23833
GENETICS
ECUT (Energy Conversion and Utilization Technologies) program: Biocatalysis Project
[NASA-CR-182917] N88-24110
GEODESY
Criteria for planimetric and altimetric correction of maps restituted from aerial photographs in 1:100,000 scale N88-24097
GEOGRAPHIC INFORMATION SYSTEMS
Remote sensing and data integration: Practical solutions for resource managers N88-24034
Implantation of a geo-cartographical information system through microcomputers N88-24064
Research on enhancing the utilization of digital multispectral data and geographic information systems in global habitability studies
[NASA-CR-182799] N88-24101
GEOGRAPHY
The Systeme d'Analyse Geographique (SAGE) geographic analysis system N88-24019
The SAGE geographic analysis system N88-24063
GEOIDS
Evaluation of a model of the Earth's gravity field
[EPSHOM-003/87] N88-24116
The determination of gravity and topography from seismic velocities, accounting for dynamic behavior of the Earth's mantle
[ETN-88-92420] N88-24117
GEOLOGICAL FAULTS
Study of fracturing for groundwater research in the Sergipe state with remote sensing products N88-24052
GEOLOGICAL SURVEYS
Solid Earth mission end-to-end data system study
[C04825.08/FR] N88-23811
GEOLOGY
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24068
GEOMETRY
The geometric workstation, a new approach for geometric corrections of remotely sensed data N88-24017
GEOMORPHOLOGY
Airborne and spaceborne radar images for geologic and environmental mapping in the Amazon rain forest, Brazil N88-24021
Subsurface morphology and geoarchaeology revealed by spaceborne and airborne radar N88-24022
Utilization of LANDSAT-TM , for aiding in the localization of archeological sites in the state of Sao Paulo N88-24069
The breaked anticlines, cuesta and crest homoclines, ortoclinal valleys, and other forms of relief outcrops delineated with the help of remote sensing imagery N88-24089
Geomorphologic sector maps of Niquizanga-Mayares, province of San Juan, Argentina N88-24098
GEOPHYSICS
An integrated study of the Alto Paranaiba Kimberlite Province, Minas Gerais, Brazil: A possible tool for diamond exploration N88-24031
GERMANIUM
Interaction of slow neutrons with Ge74 single crystals
[DE87-703010] N88-24536
GERMANIUM ALLOYS
Preparation of improved PbSnTe thermoelectric alloys and evaluation of their figure of merit
[AD-A191346] N88-24538
GERMANIUM COMPOUNDS
Improved GaP doped SiGe thermoelectric material N88-24503
GLASS
Noncontact temperature measurement in glass and other transparent materials N88-23900
Apparatus for the measurement of resistivity of glasses and ceramics N88-24460
GLASS FIBERS
Corrosion and fatique properties of FeCrB/Si metallic glass wires in aqueous environments N88-23855
GLOBAL POSITIONING SYSTEM
Investigation of air transportation technology at Ohio University, 1986 N88-23719
Integrated multisensor navigation systems N88-23722
Development of an airborne facility for advanced avionics research N88-23801
Adjustment in photogrammetry: Methods, programs and applications
[B8735130] N88-24105
GLUCOSE
Saccharification of cellulose by combined fungal and bacterial preparations N88-23833
Evaluation of the endogenous glucocorticoid hypothesis of denervation atrophy
[NASA-CR-182848] N88-24157
Design considerations for the development of an implantable sensor for the continuous measurement of glucose in the diabetic patient N88-24159
GONDOLAS
Balloon-borne three-meter telescope for far-infrared and submillimeter astronomy
[NASA-CR-182924] N88-24550
GOODNESS OF FIT
Fitting a circle to radially suppressed data
[NPL-DITC-103/87] N88-24223
GOVERNMENT/INDUSTRY RELATIONS
Civil missions applications study N88-24376
GRAFTING
Modification of polymers by photografting processes N88-23871
GRAIN BOUNDARIES
Disclination structures in carbon and graphite
[AD-A191056] N88-23868
The role of oxygen on the mechanical behavior of molybdenum alloys N88-24278
GRAIN SIZE
Analysis of dust grain properties in two star forming regions through comparison of theoretical models to observations N88-24559
GRAPHITE
Disclination structures in carbon and graphite
[AD-A191056] N88-23868
GRAPHITE-EPOXY COMPOSITES
Fuel containment, lightning protection and damage tolerance in large composite primary aircraft structures
[NASA-CR-3875] N88-23839
GRAPHS (CHARTS)
Shape detection in remote sensing through graph isomorphism N88-24028
GRASSLANDS
Mapping of plant associations and the variation of surface water in the Pantanal Mato-Grossense National Park, through remote sensing techniques N88-24092
GRATINGS (SPECTRA)
Enhancement of second harmonic generation on silver gratings by resonant excitation of surface plasmon
[ETN-88-92304] N88-24509
GRAVIMETRY
Evaluation of a model of the Earth's gravity field
[EPSHOM-003/87] N88-24116
GRAVITATIONAL EFFECTS
The determination of gravity and topography from seismic velocities, accounting for dynamic behavior of the Earth's mantle
[ETN-88-92420] N88-24117
An experiment to investigate Rankine cycle two-phase microgravity issues N88-24322
Nucleate pool boiling: High gravity to reduced gravity; liquid metals to cryogens N88-24464

GRAVITATIONAL FIELDS
Evaluation of a model of the Earth's gravity field [EPSHOM-003/87] N88-24116
Non-Newtonian gravity or gravity anomalies? [NASA-TM-4030] N88-24118
GRAVITY ANOMALIES
Non-Newtonian gravity or gravity anomalies? [NASA-TM-4030] N88-24118
GRAY SCALE
Visualization of digital terrain models N88-24081
GROOVES
An assessment of the drag reduction properties of riblets and the penalties of off-design conditions [RAE-TM-AERO-2113] N88-23731
GROUND EFFECT (AERODYNAMICS)
A numerical study of the hot gas environment around a STOVL aircraft in ground proximity [NASA-TM-100895] N88-23729
GROUND STATIONS
A low cost automatic Earth observation satellite tracking ground receiving station N88-23815
GROUND TESTS
A cyclic ground test of an ion auxiliary propulsion system: Description and operational considerations [NASA-TM-100870] N88-23829
Requirements and cost considerations for a combined space nuclear reactor test facility N88-24277
Conceptual design of the SP-100 GES test site N88-24284
Selection of a handling and maintenance option for the SP-100 ground engineering system test N88-24285
SP-100 flight qualification testing assessment N88-24414
SP-100 ground engineering systems test facility control systems N88-24496
GROUND TRUTH
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24066
Evaluation of an estimation system for an irrigated area in a tropical region through TM-LANDSAT imagery N88-24075
Evaluation of the mangrove area at the Piaui River (SE) through remote sensing N88-24086
Stereoscopic photographs, ground and aerial, of trees used in the arborization of Curitiba (PR) N88-24091
GROUND WATER
Indentification of shallow groundwater regions in semi-arid Brazil by remote sensing methods N88-24030
Study of fracturing for groundwater research in the Sergipe state with remote sensing products N88-24052
GROUP DYNAMICS
The relationship between group process and performance N88-24549
GROWTH
Mechanics of instability-related delimination growth [NASA-TM-100622] N88-23998

H

H LINES
Density diagnostics by hydrogen line intensity ratios: Excitation cross section between excited states N88-24522
H WAVES
Input-output characterization of fiber composites by SH waves [NASA-CR-4153] N88-23986
HABITATS
Research on enhancing the utilization of digital multispectral data and geographic information systems in global habitability studies [NASA-CR-182799] N88-24101
HADRONS
Quark core stars, quark stars and strange stars [DE88-006991] N88-24555
HALL EFFECT
A nuclear powered space based multimegawatt MHD disc power system N88-24471
HAMILTONIAN FUNCTIONS
Existence of periodic solutions in n-dimensional retarded functional differential equations [RR-325] N88-24221
HARDENING (MATERIALS)
Disclination structures in carbon and graphite [AD-A191056] N88-23868
HARDENING (SYSTEMS)
The electromagnetic threat to future avionic systems N88-23790
HARDNESS
Hydrogen embrittlement susceptibility of high strength ESR 4340 steel alloys for ballistically resistant/tolerant components N88-23848
HARMONIC GENERATIONS
Enhancement of second harmonic generation on silver gratings by resonant excitation of surface plasmon [ETN-88-92304] N88-24509
HAZARDOUS MATERIAL DISPOSAL (IN SPACE)
A proposed national policy concerning the reentry of space reactors N88-24359
HEAT MEASUREMENT
Note on the double crystal method of measuring heat transfer coefficient [OUEL-1710/87] N88-23950
HEAT PIPES
Transient analysis of heat pipe vapor dynamics N88-24341
Progress in the computer modeling of the liquid phase behavior of a liquid metal heat pipe N88-24342
A compressible vapor flux model for transient heat pipe analysis N88-24343
ATHENA heat pipe transient model N88-24344
Detailed transient model of a liquid-metal heat pipe N88-24345
Thermochemical analysis of mass transfer in a NB-1ZR-potassium heat pipe N88-24346
Transient thermohydraulic heat pipe modeling N88-24347
The Lewis heat pipe code with application to SP-100 GES heat pipes N88-24395
HTPIPE: A steady state heat pipe analysis program N88-24396
Heat pipe transient analysis: Vapor dynamics N88-24397
A transient model for liquid metal heat pipes N88-24398
The THROHPUT code: Thermohydraulic heat pipe modeling N88-24399
MACRAD: A mass analysis code for radiators N88-24418
Fabric radiators N88-24435
Trade study for kWe class space reactors N88-24454
Performance of vapor-fed sodium heat engine/AMTEC systems N88-24502
HEAT PUMPS
Heat pump-augmented systems for spacecraft thermal management N88-24419
HEAT RADIATORS
Thermal management for multi-modal nuclear power plants N88-24331
A review of impact design criteria for space power heat rejection systems N88-24333
Progress in the computer modeling of the liquid phase behavior of a liquid metal heat pipe N88-24342
A generalized method for optimizing the mass of space power systems N88-24369
The Curie point radiator N88-24420
Development of materials for fabric radiators N88-24448
High power density alkaline fuel cell technology for MMW space burst power N88-24451
Trade study for kWe class space reactors N88-24454
HEAT SHIELDING
Space vehicle/nuclear reactor thermal radiation integration issues N88-24417
HEAT SINKS
Assessment of energy storage concepts for use in sprint power N88-24312
Transient analysis of Li and LiH thermal storage spheres N88-24334
The effect of maximum allowable payload temperature on the mass of a multimegawatt space based platform N88-24416
HEAT SOURCES
The Light-Weight Radioisotope Heater Unit (LWRHU): Development and application N88-24299
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428
HEAT STORAGE
Assessment of energy storage concepts for use in sprint power N88-24312
Transient analysis of Li and LiH thermal storage spheres N88-24334
HEAT TRANSFER
Boundary layer measurements using hot-film sensors N88-23743
Studies of heat and mass transfer during chemical vapor deposition N88-23953
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Part 4: Aerodynamic data tabulation [NASA-CR-179469] N88-23956
Heat transfer in aerospace propulsion [NASA-TM-100874] N88-23957
Pumped two-phase heat transfer loop [NASA-CASE-MSC-20841-2] N88-23958
Botany Facility: Test report on breadboard tests for the determination of the heat transfer at the glass disk and of the temperature distribution in the fluorescent tube [BF-TN-ER-053] N88-24136
An experiment to investigate Rankine cycle two-phase microgravity issues N88-24322
Transient analysis of Li and LiH thermal storage spheres N88-24334
A liquid metal MHD concept for multimegawatt space power application N88-24348
Development of a lightweight structure with load bearing capability and high thermal conductance N88-24393
A reflux tube fabric radiator N88-24394
Heat pipe transient analysis: Vapor dynamics N88-24397
The Curie point radiator N88-24420
The liquid droplet radiator in space: A parametric approach N88-24437
Nucleate pool boiling: High gravity to reduced gravity; liquid metals to cryogens N88-24464
Reduced-gravity two-phase flow experiments in the NASA KC-135 N88-24465
Microgravity two-phase fluid flow pattern modeling N88-24467
Method and apparatus for growing crystals [NASA-CASE-MFS-28137-1] N88-24544
HEAT TRANSFER COEFFICIENTS
Note on the double crystal method of measuring heat transfer coefficient [OUEL-1710/87] N88-23950
HEAT TREATMENT
Cellular thermosetting fluoropolymers and process for making them [NASA-CASE-GSC-13008-1] N88-23894
HEAVY IONS
An evaluation of energy-independent heavy ion transport coefficient approximations [NASA-TM-101158] N88-24251
The precipitation of energetic heavy ions into the upper atmosphere of Jupiter [NASA-TM-101155] N88-24565
The Jovian aurora: Electron or ion precipitation [NASA-TM-101153] N88-24566
HELICOPTER CONTROL
Helicopter anti-torque system using fuselage strakes [NASA-CASE-LAR-13630-1] N88-23809
HELICOPTER DESIGN
Helicopter anti-torque system using fuselage strakes [NASA-CASE-LAR-13630-1] N88-23809
HELICOPTERS
Inflow measurement made with a laser velocimeter on a helicopter model in forward flight. Volume 5: Tapered planform blades at an advance ratio of 0.23 [NASA-TM-100545] N88-23755
Design and development of an avionics system adapted to helicopter missions N88-23786
HELIPORTS
Analyses of heliport system plans [DOT/FAA/PM-87/31] N88-23810
HELIUM
Preliminary analysis of helium generation and its effects on the SP-100 system performance N88-24406
HELIUM ISOTOPES
Helium-3 fusion fuel resources for space power N88-24330
Energy requirements for HE-3 mining operations on the Moon N88-24390
HELMET MOUNTED DISPLAYS
Virtual interface environment N88-24153
HERMETIC SEALS
Hermetically sealable package for hybrid solid-state electronic devices and the like [NASA-CASE-MSC-20181-1] N88-23941
HEURISTIC METHODS
Low altitude remote sensing data in the implementation of a mathematical model for the planning of urban equipment networks N88-24074
Genetic algorithms for adaptive real-time control in space systems N88-24195
Automatic program generation from specifications using PROLOG N88-24196
HIGH ENERGY INTERACTIONS
Subthreshold pion production in proton induced reactions at 180 to 201 MeV and He3 at 283 MeV [ETN-88-92303] N88-24250
HIGH FREQUENCIES
High frequency power distribution system [NASA-CR-175071] N88-23939
High frequency ultrasonic characterization of sintered SiC [NASA-TM-100825] N88-23985
HIGH LEVEL LANGUAGES
A software life cycle support environment N88-23800

A timing evaluator for C programs generated by the model system
[AD-A191204] N88-24174
A robotic language for cooperative multi-robots N88-24186

HIGH RESOLUTION
Navigation system from AVHRR data from NOAA series satellites N88-24054

HIGH REYNOLDS NUMBER
High Reynolds number tests of a Douglas DLBA 032 airfoil in the Langley 0.3-meter transonic cryogenic tunnel
[NASA-TM-87663] N88-23734

HIGH SPEED
Pressure measuring probe
[NASA-CASE-LAR-13853-1] N88-23961

HIGH STRENGTH STEELS
Hydrogen embrittlement susceptibility of high strength ESR 4340 steel alloys for ballistically resistant/tolerant components N88-23848
Brief evaluation of the alloy 17-4-PH (Z5 CNU 17-04). Semifinished product: 205 mm dia forged roller, test reports
[DF/NH-3616/84] N88-23866

HIGH TEMPERATURE
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites N88-24427
Fabric radiators N88-24435

HIGH TEMPERATURE ENVIRONMENTS
Johnson noise thermometer for high-radiation and high-temperature environments N88-24480

HIGH TEMPERATURE GASES
A numerical study of the hot gas environment around a STOVL aircraft in ground proximity
[NASA-TM-100695] N88-23729
Laser Diagnostics for combustion temperature and species measurements N88-23912

HIGH TEMPERATURE SUPERCONDUCTORS
Materials science with muon spin rotation
[NASA-CR-182891] N88-24242
Systematic variation of magnetic-field penetration depth in high-T(c) superconductors studied by muon spin relaxation N88-24243

HIGH VOLTAGES
High frequency power distribution system
[NASA-CR-175071] N88-23939

HINGES
Locking hinge
[NASA-CASE-MSC-21056-1] N88-23827

HISTOGRAMS
Almost sure L(gamma)-norm convergence for data-based histogram density estimates
[AD-A189944] N88-24228

HISTORIES
Presentation of the METEOSAT system and the roles of EUMETSAT within the meteorological community N88-24039
Sea ice kinematics: Space and time scales
[AD-A191162] N88-24128

HOLOGRAPHIC INTERFEROMETRY
Dual wavelength holographic interferometry system
[NASA-CASE-MFS-28242-1] N88-23960

HOT CORROSION
Vanadic hot corrosion of gas turbine blade coating materials N88-23864
Molten salt corrosion of SiC and Si3N4 N88-23885

HOT ELECTRONS
Hot electron diagnostics using X-ray imaging on GAMMA10 N88-24530

HOT PRESSING
Strength optimization of alpha-SiC by improved processing N88-23880
Improved silicon nitride for advanced heat engines N88-23881
Molybdenum-base cermet fuel development N88-24481

HOT-FILM ANEMOMETERS
Crossflow vorticity sensor
[NASA-CASE-LAR-13436-1-CU] N88-23759

HUBBLE SPACE TELESCOPE
TALOS: A distributed architecture for intelligent monitoring and anomaly diagnosis of the Hubble Space Telescope N88-24193

HUMAN BEINGS
Activation, strength and endurance of human respiratory and limb muscles N88-24158

HUMAN FACTORS ENGINEERING
Psychosensory cockpit ergonomics, advantages of intelligent information systems N88-23784
Designing for design effectiveness of complex avionics systems N88-23788
Experience in the integration of human engineering effort with avionics systems development N88-23793
A look toward the future of complex avionics systems development using the USAF Test Pilot School's avionics systems test training aircraft N88-23797
Space Station Human Factors Research Review. Volume 1: EVA Research and Development
[NASA-CP-2426-VOL-1] N88-24145
Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research
[NASA-CP-2426-VOL-4] N88-24148
Teleoperator human factors study
[NASA-CR-178930] N88-24162
SP-100 ground engineering systems test facility control systems N88-24496

HUMAN PERFORMANCE
The relationship between group process and performance N88-24549

HYBRID CIRCUITS
Hermetically sealable package for hybrid solid-state electronic devices and the like
[NASA-CASE-MSC-20181-1] N88-23941

HYDRODYNAMICS
The structure and stability of spherically expanding flames N88-23842
Specific features of emanation, temperature and hydrodynamic fields in the epicentral zone of tectonic earthquake
[DE88-701140] N88-24114

HYDROELECTRIC POWER STATIONS
Utilization of LANDSAT-TM imagery in the hydroenergetic inventory of the Paraiba de Sul River Basin N88-24077

HYDROGEN
Hydrogen turbines for space power systems: A simplified axial flow gas turbine model N88-24385

HYDROGEN EMBRITTLEMENT
Hydrogen embrittlement susceptibility of high strength ESR 4340 steel alloys for ballistically resistant/tolerant components N88-23848

HYDROGEN FUELS
Ultra high temperature direct propulsion N88-24275

HYDROGENATION
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844

HYDROLOGY
Evaluation of the floodable area of the canal of Sao Goncalo through TM-LANDSAT 5 imagery N88-24078
Evaluation of a flood period (June, 1984) in the southern region of Laguna dos Patos, through remote sensing data, meteorological and oceanographic N88-24083

HYDROLYSIS
Identification of hydroxypropyl starch hydrolysate components N88-23832
Saccharification of cellulose by combined fungal and bacterial preparations N88-23833
Complexation and hydrolysis reactions of iron(III) N88-23867

HYDROXYL COMPOUNDS
Identification of hydroxypropyl starch hydrolysate components N88-23832

HYPERSONIC AIRCRAFT
National aero-space plane: A technology development and demonstration program to build the X-30
[GAO/NSIAD-88-122] N88-23764
Application of integrated fluid-thermal-structural analysis methods
[NASA-TM-100625] N88-24001

HYPERSONIC FLIGHT
Review of convectively cooled structures for hypersonic flight
[NASA-TM-87740] N88-23817

HYPERSONIC FLOW
Application of integrated fluid-thermal-structural analysis methods
[NASA-TM-100625] N88-24001

HYPERVELOCITY LAUNCHERS
Power and energy requirements for electromagnetic launchers N88-24391

I

IBM COMPUTERS
Specification for IBM/IBM compatible 3480 tape cartridge
[NASA-TM-100702] N88-24168

ICE
Microgravity thaw experiment (MITEX) N88-24439
Analysis of dust grain properties in two star forming regions through comparison of theoretical models to observations N88-24559

ICE FORMATION
Investigation of air transportation technology at Massachusetts Institute of Technology, 1986 N88-23716
In-flight measurement of ice growth on an airfoil using an array of ultrasonic transducers
[AIAA-PAPER-87-0178] N88-23717
Experimental measurements of heat transfer from an iced surface during artificial and natural cloud icing conditions
[AIAA-PAPER-88-1352] N88-23718

ICE REPORTING
ERS-1 data products and services and their value for tropical countries N88-24040

ILLUMINANCE
Analysis of the parameters responsible for the variations of the illumination conditions in the LANSAT data N88-24070

ILLUMINATING
Botany Facility: Breadboarding results of the illumination system
[SIRA-A/7373/WP110/MAC003] N88-24137

IMAGE ANALYSIS
Conversational Analysis of Color Images (CAICOU): An interactive development system for the analysis of color images
[RR-641-I-IMAG-39-LIFIA] N88-23964
Textural features for image classification in remote sensing N88-24027
Practical image analysis using personal computers: The Canadian experience N88-24037
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24068
Interpretation of MSS/LANDSAT data for evaluation of physical distribution of mangroves in Cananeia-Iguape (SP) N88-24072
An update on remote measurement of soil moisture over vegetation using infrared temperature measurements: A FIFE perspective
[NASA-CR-182926] N88-24109
Generic cueing in image understanding
[RSRE-MEMO-4109] N88-24181
Linguistic definition of generic models in computer vision
[RSRE-MEMO-4110] N88-24182

IMAGE ENHANCEMENT
Dynamic range compression/expansion of light beams by photorefractive crystals
[NASA-CASE-NPO-17140-1-CU] N88-24508

IMAGE PROCESSING
Sensitivity of F-106B leading-edge-vortex images to flight and vapor-screen parameters
[NASA-TP-2818] N88-23760
Nondestructive Evaluation (NDE) of structural ceramics by photoacoustic microscopy N88-23884
Conversational Analysis of Color Images (CAICOU): An interactive development system for the analysis of color images
[RR-641-I-IMAG-39-LIFIA] N88-23964
Some problems with regard to the TOVS processing detected by using NOAA-HRPT data check program N88-24009
Enhanced infra-red picture of LR-FAX for spring and autumn seasons N88-24011
Latin American Symposium on Remote Sensing, 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, volume 1 N88-24013
Textural features for image classification in remote sensing N88-24027
The USSR space systems for remote sensing of earth resources and the environment (sensor systems, processing techniques, applications) N88-24035
Evolution of a family of image processing systems at INPE N88-24065
Study of methods of post-processing applied to a problem of standard classification N88-24067
Interpretation of MSS/LANDSAT data for evaluation of physical distribution of mangroves in Cananeia-Iguape (SP) N88-24072
COMTAL vision one/20 programming processor system from the VAX 11/780 N88-24079
Automatic registration of satellite imagery N88-24080
Application of its transformation in color enhancement of LANDSAT imagery N88-24082
Restrictions in activity monitoring through remote sensing N88-24084
Preliminary study on the application of digital processing of TM-LANDSAT data in the mapping of apple orchards in Fraiburgo (SC) N88-24093
Evaluation of TM false color composites for crop discrimination N88-24096
Terrain classification using SPOT images and the computer system GOP-300
[FOA-C-20677-2.7] N88-24102
Adjustment in photogrammetry: Methods, programs and applications
[B8735130] N88-24105
Image management research N88-24150

Generic cueing in image understanding
[RSRE-MEMO-4109] N88-24181
Orbital navigation, docking and obstacle avoidance as a form of three dimensional model-based image understanding N88-24194
Application of spline functions to digital image processing
[ETN-88-92194] N88-24218

IMAGERY
Television monitor field shifter and an opto-electronic method for obtaining a stereo image of optimal depth resolution and reduced depth distrotion on a single screen
[NASA-CASE-NPO-17249-1-CU] N88-23924

IMAGING TECHNIQUES
Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, volume 1 N88-24013
The geometric workstation, a new approach for geometric corrections of remotely sensed data N88-24017
Subsurface morphology and geoarchaeology revealed by spaceborne and airborne radar N88-24022
Mapping soil and rock variation from satellite images in the Sahel N88-24023
Textural features for image classification in remote sensing N88-24027
Shape detection in remote sensing through graph isomorphism N88-24028
The modeling of error budget analysis and tolerance specifications for BRESEX multiband linear array CCD camera N88-24029
Practical image analysis using personal computers: The Canadian experience N88-24037
Comparison of the solar radiation estimation method by satellites N88-24055
Study of methods of post-processing applied to a problem of standard classification N88-24067
Analysis of the parameters responsible for the variations of the illumination conditions in the LANSAT data N88-24070
COMTAL vision one/20 programming processor system from the VAX 11/780 N88-24079
Automatic registration of satellite imagery N88-24080
Application of its transformation in color enhancement of LANDSAT imagery N88-24082
Evaluation of TM false color composites for crop discrimination N88-24096
Novel silicon Schottky barrier infrared imaging arrays N88-24510

IMPACT DAMAGE
GARTEUR TP-037: Impact damage tolerance of carbon fiber and hybrid laminates
[RAE-TR-87057] N88-23837
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428

IMPACT LOADS
Behavior of a two-layered beam under impact loading
[OUEL-1716/87] N88-23993

IMPACT TOLERANCES
Fuel containment, lightning protection and damage tolerance in large composite primary aircraft structures
[NASA-CR-3875] N88-23839

IMPEDANCE
AC impedance analysis of corrosion fatigue in naval aircraft alloys
[AD-A190822] N88-23865

IMPLANTATION
Design considerations for the development of an implantable sensor for the continuous measurement of glucose in the diabetic patient N88-24159

IMPROVEMENT
Parameter identification methods for improving structural dynamic models
[NASA-TM-100812] N88-23994

IMPURITIES
Observation of injected silicon in heliotron E N88-24524
Flux density measurements of neutral iron in TEXTOR with laser induced fluorescence N88-24528

INCOMPRESSIBLE FLOW
The exact calculation of quadrupole sources for some incompressible flows
[NASA-TM-100623] N88-24240

INCOMPRESSIBLE FLUIDS
Theoretical studies of solar lasers and converters
[NASA-CR-182927] N88-23972

INDEPENDENT VARIABLES
Improved estimators in simultaneous estimation of scale parameters
[AD-A191108] N88-24216

INDEXES (DOCUMENTATION)
Engine structures: A bibliography of Lewis Research Center's research for 1980-1987
[NASA-TM-100842] N88-24002

INDUCTION (MATHEMATICS)
Induction of models under uncertainty
[NASA-TM-101173] N88-24230

INDUCTORS
Advanced thermionic converter technology for inductive output coupling N88-24311

INDUSTRIES
Defense Small Business Innovation Research Program (SBIR). Volume 3: Air Force abstracts of phase 1 awards, 1987 N88-24548

INELASTIC COLLISIONS
Forbidden transitions as ion-temperature sensitive lines N88-24520

INERTIAL CONFINEMENT FUSION
Interplanetary propulsion using inertial fusion N88-24273

INERTIAL FUSION (REACTOR)
Interplanetary propulsion using inertial fusion N88-24273

INFERENCE
Induction of models under uncertainty
[NASA-TM-101173] N88-24230

INFORMATION
Interfacing and integrating hardware and software design systems N88-23796

INFORMATION DISSEMINATION
Presentation of the METEOSAT system and the roles of EUMETSAT within the meteorological community N88-24039

INFORMATION FLOW
Rapid prototyping of complex avionic system architectures N88-23771

INFORMATION MANAGEMENT
Crewstation Information and Development System (CIDS) N88-23781
Designing for design effectiveness of complex avionics systems N88-23788
Space Power Reference Source (SPRS): A user's guide to SDI Space Power Technology Programs N88-24440

INFORMATION THEORY
Error control techniques for satellite and space communications
[NASA-CR-182886] N88-23922

INFORMATION TRANSFER
Sky radiance distributions for thermal imaging backgrounds
[AD-A191135] N88-24115

INFRARED ASTRONOMY
Balloon-borne three-meter telescope for far-infrared and submillimeter astronomy
[NASA-CR-182924] N88-24550

INFRARED DETECTORS
Novel silicon Schottky barrier infrared imaging arrays N88-24510

INFRARED IMAGERY
Infrared radiometric technique in temperature measurement N88-23913
Real time thermal imaging of high temperature semiconductor melts N88-23914
Enhanced infra-red picture of LR-FAX for spring and autumn seasons N88-24011
An update on remote measurement of soil moisture over vegetation using infrared temperature measurements: A FIFE perspective
[NASA-CR-182926] N88-24109
Sky radiance distributions for thermal imaging backgrounds
[AD-A191135] N88-24115

INFRARED RADIATION
Estimation of total Outgoing Longwave Radiation (OLR) flux from geostationary meteorological satellite infrared window radiance N88-24006

INFRARED RADIOMETERS
Noncontact Temperature Measurement
[NASA-CP-2503] N88-23895
Radiation thermometry: The measurement problem N88-23896
The role of fiberoptics in remote temperature measurement N88-23909
Infrared radiometric technique in temperature measurement N88-23913

INFRARED TELESCOPES
Balloon-borne three-meter telescope for far-infrared and submillimeter astronomy
[NASA-CR-182924] N88-24550

INFRARED WINDOWS
Estimation of total Outgoing Longwave Radiation (OLR) flux from geostationary meteorological satellite infrared window radiance N88-24006

INGESTION (ENGINES)
A numerical study of the hot gas environment around a STOVL aircraft in ground proximity
[NASA-TM-100895] N88-23729

INGOTS
Compositional redistribution during casting of Hg sub 0.8 Cd sub 0.2 Te alloys
[NASA-TM-101151] N88-23893

INHIBITORS
Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2
[AD-A189660] N88-23847
Development of microencapsulated DNBM quaternary ammonium inhibitors for paints N88-23851

INJECTION MOLDING
Improved silicon carbide for advanced heat engines N88-23879
Improved silicon nitride for advanced heat engines N88-23881

INLET FLOW
Numerical simulation of scramjet inlet flow fields
[NASA-TP-2517] N88-23735

INLET NOZZLES
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Part 4: Aerodynamic data tabulation
[NASA-CR-179469] N88-23956

INSERTS
Insert design handbook
[ESA-PSS-03-1202-ISSUE-1] N88-23822

INSPECTION
Method of radiographic inspection of wooden members
[NASA-CASE-LAR-13724-1] N88-23983

INSTALLING
The Environment for Application Software Integration and Execution (EASIE) version 1.0. Volume 4: System installation and maintenance guide
[NASA-TM-100576] N88-24185

INSTRUMENT APPROACH
Investigation of air transportation technology at Massachusetts Institute of Technology, 1986 N88-23716
Loran-C monitor correlation over a 92-mile baseline in Ohio N88-23720

INSTRUMENT ERRORS
Common but unappreciated sources of error in one, two, and multiple-color pyrometry N88-23907

INSTRUMENT FLIGHT RULES
Rule-based fault-tolerant flight control N88-23725

INTAKE SYSTEMS
A numerical study of the hot gas environment around a STOVL aircraft in ground proximity
[NASA-TM-100895] N88-23729
Inflow measurement made with a laser velocimeter on a helicopter model in forward flight. Volume 5: Tapered planform blades at an advance ratio of 0.23
[NASA-TM-100545] N88-23755

INTEGRAL EQUATIONS
Parameter estimation for boundary value problems by integral equations of the second kind
[NASA-CR-181660] N88-23918
A new collocation-type method for the numerical solution of Hammerstein equations N88-24226

INTEGRATED OPTICS
Monolithic integration on a GaAs substrate of a quarter ring laser and an optical guide coupled by an evanescent wave
[ETN-88-92308] N88-23969

INTERACTIVE CONTROL
EnviroNET: An interactive space-environment information resource
[NASA-TM-101137] N88-23812

INTERFACE STABILITY
Agenda for advancing electrochemical science and technology N88-23861

INTERFACES
Test philosophy of the EH101 integrated avionic N88-23775
Interfacing and integrating hardware and software design systems N88-23796
Polyitaconic acid macromolecule primer for adhesive bonding and corrosion control of aluminum N88-23849

INTERGRANULAR CORROSION
Stress corrosion cracking properties of Al-Li alloys N88-23853
The effect of titanium reinforcement on the life of positive grids in lead-acid batteries N88-23857

INTERMETALLICS
Coexisting static magnetic ordering and superconductivity in CeCu2.1Si2 found by muon spin relaxation N88-24245
Static magnetic ordering of CeCu2.1Si2 found by muon spin relaxation N88-24246

INTERNAL COMBUSTION ENGINES
Composite piston
[NASA-CASE-LAR-13435-1] N88-23981

INTERNATIONAL COOPERATION
International cooperation in remote sensing: The ESA experience N88-24038
Discussions and agreements in the United Nations on important issues associated with nuclear power in space N88-24411
INTERPLANETARY FLIGHT
Trade study for kWe class space reactors N88-24454
INTERPROCESSOR COMMUNICATION
A five-layer Open Systems Interconnection (OSI) implementation N88-24204
Interconnection of high-speed local area networks N88-24205
INTERSTELLAR TRAVEL
Engineering planetary lasers for interstellar communication
[NASA-CR-180780] N88-23825
INVENTORIES
Utilization of LANDSAT-TM imagery in the hydroenergetic inventory of the Paraiba do Sul River Basin N88-24077
INVISCID FLOW
Numerical method for unsteady viscous-inviscid interaction to calculate buffeting
[ONERA-RSF-02/3617-AY-008-A] N88-23949
IODINE LASERS
Theoretical studies of solar lasers and converters
[NASA-CR-182927] N88-23972
ION BEAMS
Ion beam alloying of aluminum for corrosion resistance N88-23860
ION DENSITY (CONCENTRATION)
Spectral diagnostics for temperature and density measurements on ATF N88-24525
ION ENGINES
Megawatt level electric propulsion perspectives N88-24294
Electric propulsion options for the SP-100 reference mission N88-24296
TRICE design, evaluation and feasibility tests N88-24498
ION EXTRACTION
Ion generator and ion application system
[NASA-CASE-MFS-28122-1] N88-24253
ION IMPLANTATION
Microelectronics the next fifteen years N88-23792
Ion beam alloying of aluminum for corrosion resistance N88-23860
ION PROPULSION
A cyclic ground test of an ion auxiliary propulsion system: Description and operational considerations
[NASA-TM-100870] N88-23829
High power ion thruster performance N88-24295
ION SHEATHS
Irradiation test results on thermionic fuel element sheath insulators N88-24280
ION TEMPERATURE
Ion temperature measurement with spectroscopy in JT-60 N88-24513
Ion temperature profile measurement using charge exchange recombination spectroscopy on JIPP T-IIU N88-24518
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D N88-24519
Forbidden transitions as ion-temperature sensitive lines N88-24520
Spectroscopic study of heliotron E plasmas: Stark profile, CXR, poloidal rotation and carbon coating N88-24523
Spectral diagnostics for temperature and density measurements on ATF N88-24525
IONIC COLLISIONS
Distorted-wave-method calculation of electron-impact excitation of atomic ions N88-24532
IONIZATION
Ion generator and ion application system
[NASA-CASE-MFS-28122-1] N88-24253
IONIZING RADIATION
Point defects in irradiated silicates N88-24319
Modeling of radiation dose dependence of MOSFETs N88-24370
IONS
Centrifugal acceleration of ions in the polar magnetosphere
[NASA-TM-101148] N88-24120
IRIDIUM
Weldability of general purpose heat source iridium capsules N88-24429
IRON
Complexation and hydrolysis reactions of iron(III) N88-23867
Flux density measurements of neutral iron in TEXTOR with laser induced fluorescence N88-24528
IRRADIATION
Irradiation test results on thermionic fuel element sheath insulators N88-24280
The effect of elevated temperature on irradiated MOS devices N88-24308
An irradiation performance data base for nitride fuels N88-24438
Material property and irradiation performance correlations for nitride fuels N88-24483
IRRIGATION
Evaluation of an estimation system for an irrigated area in a tropical region through TM-LANDSAT imagery N88-24075
ISOSTATIC PRESSURE
Strength optimization of alpha-SiC by improved processing N88-23880
Improved silicon nitride for advanced heat engines N88-23881
Fabrication of reactor shields at the Y-12 plant N88-24283
ISOTOPES
The dynamic isotope power system: Technology status and demonstration program N88-24400
Characteristics of the closed Brayton cycle for dynamic isotope power systems N88-24401
Dynamic isotope power system critical component verification N88-24421
SNAP-DYN: Proven technology for wear-term, higher power in space N88-24422
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428
ITERATIVE SOLUTION
Electromagnetic scattering from nonlinear anisotropic cylinders N88-23930
Fitting a circle to radially suppressed data
[NPL-DITC-103/87] N88-24223
IUE
IUE evidence on the nature of the innermost broad-line region in Seyfert 1 galaxies N88-24552

J

JET FLOW
Acoustically excited heated jets. 1: Internal excitation
[NASA-CR-4129-PT-1] N88-23751
Acoustically excited heated jets. 2: In search of a better understanding
[NASA-CR-4129-PT-2] N88-23752
JET MIXING FLOW
Saturation and the limit of jet mixing enhancement by single frequency plane wave excitation: Experiment and theory
[NASA-TM-100882] N88-23732
Acoustically excited heated jets. 1: Internal excitation
[NASA-CR-4129-PT-1] N88-23751
Acoustically excited heated jets. 2: In search of a better understanding
[NASA-CR-4129-PT-2] N88-23752
Acoustically excited heated jets. 3: Mean flow data
[NASA-CR-4129-PT-3] N88-23753
JOINTS (JUNCTIONS)
Manufacturing requirements N88-23745
Bearing-bypass material system test
[NASA-CASE-LAR-13458-1] N88-23967
JUPITER (PLANET)
The precipitation of energetic heavy ions into the upper atmosphere of Jupiter
[NASA-TM-101155] N88-24565
The Jovian aurora: Electron or ion precipitation
[NASA-TM-101153] N88-24566
JUPITER ATMOSPHERE
The precipitation of energetic heavy ions into the upper atmosphere of Jupiter
[NASA-TM-101155] N88-24565

K

KEYING
Reconfigurable work station for a video display unit and keyboard
[NASA-CASE-MFS-26009-1-SB] N88-24163
KINEMATICS
Sea ice kinematics: Space and time scales
[AD-A191162] N88-24128
KINETIC EQUATIONS
Consistent transport coefficients in astrophysics
[NASA-TM-101154] N88-24560
KRYPTON
Krypton based adsorption type cryogenic refrigerator
[NASA-CASE-NPO-17334-1-CU] N88-23917

L

LABORATORY EQUIPMENT
Impact of control errors on the volume/weight demand of the Ventilation and Dryer (VAD) concept — EURECA Botany Facility
[TN-RB524-006/87] N88-24132
Botany Facility pre-phase C/D. Core payload for EURECA, volume 1
[BF-RP-ER-015-VOL-1] N88-24144
LAMINAR BOUNDARY LAYER
Boundary-layer stability and airfoil design N88-23738
LAMINAR FLOW
Laminar Flow Aircraft Certification
[NASA-CP-2413] N88-23737
Boundary-layer stability and airfoil design N88-23738
High-flaps for natural laminar flow airfoils N88-23739
Computational wing design studies relating to natural laminar flow N88-23740
Wind tunnel testing of low-drag airfoils N88-23741
Flight experiences with laminar flow N88-23744
Manufacturing requirements N88-23745
Preliminary aerodynamic design considerations for advanced laminar flow aircraft configurations N88-23746
Natural laminar flow and airplane stability and control N88-23747
Operational considerations for laminar flow aircraft N88-23748
Certification aspects of airplanes which may operate with significant natural laminar flow N88-23749
LAMINAR FLOW AIRFOILS
Laminar Flow Aircraft Certification
[NASA-CP-2413] N88-23737
Pressure distributions from subsonic tests of an advanced laminar-flow-control wing with leading- and trailing-edge flaps
[NASA-TM-4040-PT-1] N88-23758
LAMINATES
GARTEUR TP-037: Impact damage tolerance of carbon fiber and hybrid laminates
[RAE-TR-87057] N88-23837
LAND USE
Landuse and landform studies of the Mahanadi River Delta with the help of satellite MSS band N88-24033
Remote sensing techniques in the estimation of the area cultivated with beans, corn, and castor beans in the Irece County (Bahia State) N88-24045
CANASATE: Sugar cane mapping by satellite N88-24046
Utilization of LANDSAT-TM imagery in the hydroenergetic inventory of the Paraiba do Sul River Basin N88-24077
Preliminary study on the application of digital processing of TM-LANDSAT data in the mapping of apple orchards in Fraiburgo (SC) N88-24093
Research on enhancing the utilization of digital multispectral data and geographic information systems in global habitability studies
[NASA-CR-182799] N88-24101
Coupling of satellite remote sensing to digitized topographic map to detect changes in land use
[B8735129] N88-24104
LANDSAT SATELLITES
Mapping soil and rock variation from satellite images in the Sahel N88-24023
LANTHANUM OXIDES
Comparison between muon spin rotation and neutron scattering studies on the 3-dimensional magnetic ordering of La2CuO(4-y) N88-24244
LARGE SPACE STRUCTURES
Travelling wave concepts for the modeling and control of space structures
[AD-A191235] N88-23819
Soviet spacecraft engineering research
[FASAC-TAR-3090] N88-23823
LDR structural experiment definition
[NASA-TM-100618] N88-23826
Space spider crane
[NASA-CASE-LAR-13411-1-SB] N88-23828
Continuum modeling and dynamic analysis of large truss structures N88-23995
LASER APPLICATIONS
Laser pyrometry N88-23910
Noncontact true temperature measurement, 2 N88-23911
Laser Diagnostics for combustion temperature and species measurements N88-23912
Research investigation directed toward extending the useful range of the electromagnetic spectrum
[AD-A190198] N88-23920
Research investigation directed toward extending the useful range of the electromagnetic spectrum, appendix
[AD-A190199] N88-23921

Cascade fluorescences from laser-excited lithium atom for plasma diagnostics N88-24526
Flux density measurements of neutral iron in TEXTOR with laser induced fluorescence N88-24528
LASER DOPPLER VELOCIMETERS
Inflow measurement made with a laser velocimeter on a helicopter model in forward flight. Volume 5: Tapered planform blades at an advance ratio of 0.23 [NASA-TM-100545] N88-23755
LASER FUSION
Interplanetary propulsion using inertial fusion N88-24273
LASER OUTPUTS
Realization of an XeCl laser producing 100W on average [ETN-88-92541] N88-23970
LASER PUMPING
Space based nuclear-pumped laser/reactor concepts N88-24289
LASER RANGER/TRACKER
Solid Earth mission end-to-end data system study [C04825.08/FR] N88-23811
LASER SPECTROSCOPY
Laser Diagnostics for combustion temperature and species measurements N88-23912
LASER WEAPONS
Power source selection for neutral particle beam systems N88-24314
Nuclear reactor magnetohydrodynamic power generator for directed energy weapons N88-24336
Fundamental analysis of space nuclear-MHD generator for gigawatt-level power N88-24337
Rotating-hoop, pulsed-energy converter N88-24433
Space Power Reference Source (SPRS): A user's guide to SDI Space Power Technology Programs N88-24440
Monolithic fuel cell based power source for burst power generation N88-24450
LASERS
Theoretical studies of Resonance Enhanced Stimulated Raman Scattering (RESRS) of frequency doubled Alexandrite laser wavelength in cesium vapor [NASA-CR-182871] N88-23841
LATERAL CONTROL
Control law parameterization for an aeroelastic wind-tunnel model equipped with an active roll control system and comparison with experiment [NASA-TM-100593] N88-23807
LATERAL STABILITY
Natural laminar flow and airplane stability and control N88-23747
LATITUDE
Latitudinal and seasonal variation of the cloud characteristic parameters and their effects on the cloud classification N88-24005
Navigation system from AVHRR data from NOAA series satellites N88-24054
LAUNCHING SITES
Soil erosion and causative factors at Vandenberg Air Force Base, California [NASA-TM-100981] N88-24156
LEACHING
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844
LEAD ACID BATTERIES
The effect of titanium reinforcement on the life of positive grids in lead-acid batteries N88-23857
LEAD TELLURIDES
Preparation of improved PbSnTe thermoelectric alloys and evaluation of their figure of merit [AD-A191346] N88-24538
LEADING EDGE FLAPS
High-flaps for natural laminar flow airfoils N88-23739
Pressure distributions from subsonic tests of an advanced laminar-flow-control wing with leading- and trailing-edge flaps [NASA-TM-4040-PT-1] N88-23758
LEADING EDGES
Operational considerations for laminar flow aircraft N88-23748
Sensitivity of F-106B leading-edge-vortex images to flight and vapor-screen parameters [NASA-TP-2818] N88-23760
A comparison of experimental and calculated thin-shell leading-edge buckling due to thermal stresses [NASA-TM-100416] N88-23999
LEAKAGE
Monte Carlo analysis of lateral collection diode arrays [RSRE-MEMO-4080] N88-23938
LEGUMINOUS PLANTS
Remote sensing techniques in the estimation of the area cultivated with beans, corn, and castor beans in the Irece County (Bahia State) N88-24045
LIFE (DURABILITY)
Ceramics for turbine engines N88-23873
Thermal cyclic durability testing of ceramic materials for turbine engines N88-23886
Fractographic and microstructural evaluation of 3500-hour durability specimens N88-23887
Space reactor end of life issues N88-24413
LIFE CYCLE COSTS
The multi-disciplinary design study: A life cycle cost algorithm [NASA-CR-4156] N88-24172
LIFE SCIENCES
USSR Space Life Sciences Digest, Issue 17 [NASA-CR-3922(20)] N88-24155
LIFE SUPPORT SYSTEMS
Life Support Subsystem (LSS). Concept for the Botany Facility --- EURECA [TN-RB524-107/86] N88-24131
Summary of the activities performed during the Botany Facility (BF) predevelopment phase for the Life Support S/S (LSS) [TB-RB524-002/87] N88-24133
Subsea approach to work systems development N88-24146
LIFT
Propulsive performance of a lifting flapping wing N88-23733
LIFT DEVICES
High-flaps for natural laminar flow airfoils N88-23739
LIGHT (VISIBLE RADIATION)
Research investigation directed toward extending the useful range of the electromagnetic spectrum [AD-A190198] N88-23920
LIGHT AIRCRAFT
It's time to reinvent the general aviation airplane N88-23726
LIGHT MODULATION
Research investigation directed toward extending the useful range of the electromagnetic spectrum, appendix [AD-A190199] N88-23921
LIGHT SCATTERING
Analysis of dust grain properties in two star forming regions through comparison of theoretical models to observations N88-24559
LIGHTNING
Finite element simulation of the atmosphere's electromagnetic response to charge perturbations associated with lightning N88-24124
LIGHTNING SUPPRESSION
Fuel containment, lightning protection and damage tolerance in large composite primary aircraft structures [NASA-CR-3875] N88-23839
LINE SPECTRA
Total photoionization cross sections of atomic oxygen from threshold to 44.3A [NASA-CR-182992] N88-24252
Helium-like titanium spectra from tokamak plasmas N88-24516
Forbidden transitions as ion-temperature sensitive lines N88-24520
Tokamak studies of density sensitive line ratios N88-24521
Intensity calibration of a VUV system by branching line pairs N88-24533
The gamma 1 and gamma 3 bands of (16)O3: Line positions and intensities [NASA-TM-101162] N88-24541
Line positions and intensities for the gamma 1 + gamma 2 and gamma 2 + gamma 3 bands of (16)O3 [NASA-TM-101161] N88-24542
LINEAR QUADRATIC GAUSSIAN CONTROL
State covariance assignment of discrete systems: Development and applications N88-24225
LINEAR SYSTEMS
The LDCM actuator for vibration suppression [NASA-CR-182898] N88-23940
State covariance assignment of discrete systems: Development and applications N88-24225
LININGS
Compositional redistribution during casting of Hg sub 0.8 Cd sub 0.2 Te alloys [NASA-TM-101151] N88-23893
LIQUID AMMONIA
Ammonia cleanup of lithium containing components N88-24287
LIQUID COOLED REACTORS
Gas-cooled reactor power systems for space N88-24350
LIQUID COOLING
Single phase liquid immersion cooling of discrete heat sources in a vertical channel [AD-A191224] N88-23944
The liquid droplet radiator in space: A parametric approach N88-24437
LIQUID HELIUM
Preliminary study of niobium alloy contamination by transport through helium N88-24279
LIQUID HYDROGEN
Rotor self-lubricating axial stop [NASA-CASE-MFS-28273-1] N88-23974
LIQUID LITHIUM
Ammonia cleanup of lithium containing components N88-24287
Transient analysis of Li and LiH thermal storage spheres N88-24334
Fabrication of a niobium 1 percent zirconium containment for SP-100 primary lithium system materials mass transfer studies N88-24373
Liquid metal testing at ETEC for the SP-100 program N88-24446
LIQUID METAL COOLED REACTORS
Status of CEA design and simulation studies of a 200 KWe turboelectric space power system N88-24268
Conceptual design of the SP-100 GES test site N88-24284
Selection of a handling and maintenance option for the SP-100 ground engineering system test N88-24285
Fast critical experiment data for space reactors N88-24286
A review of diffusion barrier technology for application in SP-100 fuel pins N88-24328
Liquid-metal MHD power conversion for space electric systems N88-24338
Studies for the definition of a Faraday converter for space nuclear systems N88-24339
A liquid metal MHD concept for multimegawatt space power application N88-24348
Nuclear Rankine/flywheel MMW space power concept N88-24349
A dynamic model for the aft accumulator in the TE SP-100 system N88-24354
Parametric analyses of the TE SP-100 system performance N88-24358
Advanced LMMHD space power generation concept N88-24364
Transient analyses of multimegawatt space reactors N88-24456
LIQUID METALS
Detailed transient model of a liquid-metal heat pipe N88-24345
A transient model for liquid metal heat pipes N88-24398
The THROHPUT code: Thermohydraulic heat pipe modeling N88-24399
Possible creep studies of lithium with a compact device N88-24404
Review of alkali metal and refractory alloy compatibility for Rankine cycle applications N88-24447
Nucleate pool boiling: High gravity to reduced gravity; liquid metals to cryogens N88-24464
LIQUID OXYGEN
Rotor self-lubricating axial stop [NASA-CASE-MFS-28273-1] N88-23974
LIQUID PHASES
Progress in the computer modeling of the liquid phase behavior of a liquid metal heat pipe N88-24342
Microgravity thaw experiment (MITEX) N88-24439
LIQUID POTASSIUM
Design of a high-power-density Ljungstroem turbine using potassium as a working fluid N88-24323
Nuclear Rankine/flywheel MMW space power concept N88-24349
LIQUID SODIUM
Sodium heat engine/AMTEC system experiments N88-24325
LIQUID-GAS MIXTURES
Theoretical and experimental investigation of swirl flow phase separators for microgravity applications N88-24335
Experimental investigation of a microgravity separator for two phase mixtures containing small volumes of gas/vapor N88-24468
LIQUID-VAPOR INTERFACES
An experiment to investigate Rankine cycle two-phase microgravity issues N88-24322
LIQUIDS
Direct emissivity measurements on liquids and corrections to multi-color pyrometers N88-23906
LITHIUM
A transient model for liquid metal heat pipes N88-24398
The THROHPUT code: Thermohydraulic heat pipe modeling N88-24399
Possible creep studies of lithium with a compact device N88-24404
LITHIUM ALLOYS
Stress corrosion cracking properties of Al-Li alloys N88-23853
LITHIUM HYDRIDES
Fabrication of lithium hydride shields for space nuclear power systems N88-24282
Fabrication of reactor shields at the Y-12 plant N88-24283
Transient analysis of Li and LiH thermal storage spheres N88-24334

Energy storage for nuclear burst power systems N88-24431

LITHOGRAPHY
Microelectronics the next fifteen years N88-23792

LITHOLOGY
Analysis and interpretation of image lithostructure: An application of the multiconcept in the metamorphic belt of Sul de Santana da Boa Vista (RS) N88-24051
Some geological aspects of the Pirapemas Lineament Belt N88-24090
Lithostructural interpretation of Chapda do Cachimbo (Pa-Am-Mt), based on radar and LANDSAT imagery N88-24100

LOAD DISTRIBUTION (FORCES)
Development of a lightweight structure with load bearing capability and high thermal conductance N88-24393

LOAD TESTING MACHINES
Bearing-bypass material system test [NASA-CASE-LAR-13458-1] N88-23967

LOCAL AREA NETWORKS
DATAC bus monitor N88-23721
Development of a generic architecture N88-23774
Interconnection of high-speed local area networks N88-24205

LOCKING
Locking hinge [NASA-CASE-MSC-21056-1] N88-23827

LONG TERM EFFECTS
Fractographic and microstructural evaluation of 3500-hour durability specimens N88-23887

LONG WAVE RADIATION
Estimation of total Outgoing Longwave Radiation (OLR) flux from geostationary meteorological satellite infrared window radiance N88-24006

LONGITUDE
Navigation system from AVHRR data from NOAA series satellites N88-24054

LONGITUDINAL STABILITY
Natural laminar flow and airplane stability and control N88-23747

LONGITUDINAL WAVES
Generation of flux tube waves in stellar convection zones. 1: Longitudinal tube waves [NASA-TM-101152] N88-24561

LORAN C
Investigation of air transportation technology at Massachusetts Institute of Technology, 1986 N88-23716
Investigation of air transportation technology at Ohio University, 1986 N88-23719
Loran-C monitor correlation over a 92-mile baseline in Ohio N88-23720
Integrated multisensor navigation systems N88-23722

LOSS OF COOLANT
Inherently safe space reactors N88-24363

LOW TEMPERATURE
Cellular thermosetting fluoropolymers and process for making them [NASA-CASE-GSC-13008-1] N88-23894

LUMINOUS INTENSITY
Analysis of dust grain properties in two star forming regions through comparison of theoretical models to observations N88-24559

LUNAR BASES
Multimegawatt nuclear power system for lunar base applications N88-24367
Applications of nuclear power to lunar and Mars missions N88-24377
Electromagnetic powered vehicles (EMPV) for Mars exploration N88-24388

LUNAR SURFACE
Energy requirements for HE-3 mining operations on the Moon N88-24390

M

MACH NUMBER
Aeropropulsive characteristics of isolated combined turbojet/ramjet nozzles at Mach numbers from 0 to 1.20 [NASA-TP-2814] N88-23757

MAGNETIC BEARINGS
Vibration and control of flexible rotor supported by magnetic bearings [NASA-TM-100888] N88-23977

MAGNETIC FIELDS
Magnetic drive coupling [NASA-CASE-MSC-21171-1] N88-23973
Systematic variation of magnetic-field penetration depth in high-T(c) superconductors studied by muon spin relaxation N88-24243

MAGNETIC FLUX
Generation of flux tube waves in stellar convection zones. 1: Longitudinal tube waves [NASA-TM-101152] N88-24561

MAGNETIC INDUCTION
Magnetic drive coupling [NASA-CASE-MSC-21171-1] N88-23973

MAGNETIC PROPERTIES
Coexisting static magnetic ordering and superconductivity in CeCu2.1Si2 found by muon spin relaxation N88-24245
Static magnetic ordering of CeCu2.1Si2 found by muon spin relaxation N88-24246

MAGNETIC SHIELDING
Magnet shielding analysis for SOAR: A space fusion reactor N88-24269

MAGNETIC TAPES
Specification for IBM/IBM compatible 3480 tape cartridge [NASA-TM-100702] N88-24168

MAGNETOHYDRODYNAMIC GENERATORS
Acoustical gas core reactor with MHD power generation for burst power in a bimodal system N88-24290
Fluid dynamics of spherical cavity reactors N88-24291
Nuclear reactor magnetohydrodynamic power generator for directed energy weapons N88-24336
Fundamental analysis of space nuclear-MHD generator for gigawatt-level power N88-24337
Liquid-metal MHD power conversion for space electric systems N88-24338
Studies for the definition of a Faraday converter for space nuclear systems N88-24339
A liquid metal MHD concept for multimegawatt space power application N88-24348
Advanced LMMHD space power generation concept N88-24364
A multimegawatt space power source radiator design N88-24436
A nuclear powered space based multimegawatt MHD disc power system N88-24471
Burst power gas core reactor with MHD power generation N88-24472

MAGNETOHYDRODYNAMICS
Gigawatt, closed cycle, vapor core-MHD space power system conceptual design study N88-24473
Generation of flux tube waves in stellar convection zones. 1: Longitudinal tube waves [NASA-TM-101152] N88-24561

MAGNETRON SPUTTERING
Method of producing high T(subc) superconducting NBN films [NASA-CASE-NPO-16681-1-CU] N88-24543

MAINTENANCE
The Environment for Application Software Integration and Execution (EASIE) version 1.0. Volume 4: System installation and maintenance guide [NASA-TM-100576] N88-24185
Aerospace energy systems laboratory: Requirements and design approach [NASA-TM-100423] N88-24206
Selection of a handling and maintenance option for the SP-100 ground engineering system test N88-24285

MALFUNCTIONS
TALOS: A distributed architecture for intelligent monitoring and anomaly diagnosis of the Hubble Space Telescope N88-24193

MAN MACHINE SYSTEMS
Development and testing of a predictive methodology for optimization of man-machine interface in future avionics systems N88-23780
Crewstation Information and Development System (CIDS) N88-23781
A change in system design emphasis: From machine to man N88-23782
Psychosensory cockpit ergonomics, advantages of intelligent information systems N88-23784
Experience in the integration of human engineering effort with avionics systems development N88-23793
A look toward the future of complex avionics systems development using the USAF Test Pilot School's avionics systems test training aircraft N88-23797
Teleoperator human factors study [NASA-CR-178930] N88-24162
Dialog design: General requirements and analysis of an Ada system --- user interface design [FOA-C-20691-2.7] N88-24177

MAN-COMPUTER INTERFACE
Virtual interface environment N88-24153

MANAGEMENT
Models and metrics for software management and engineering [NASA-CR-182953] N88-24200

MANAGEMENT PLANNING
The challenges and opportunities of supersonic transport propulsion technology [NASA-TM-100921] N88-23806

MANEUVERABLE SPACECRAFT
National aero-space plane: A technology development and demonstration program to build the X-30 [GAO/NSIAD-88-122] N88-23764

MANIPULATORS
Space spider crane [NASA-CASE-LAR-13411-1-SB] N88-23828
A design analysis for an automated robotic workpiece manipulator N88-23975
Point accessibility and primary workspace of simple six-link robots N88-23976
Precise computer controlled positioning of robot end effectors using force sensors [NASA-CR-182887] N88-24213
Energy optimal trajectory planning for robot manipulators and autonomous vehicles N88-24497

MANNED MARS MISSIONS
Applications of nuclear power to lunar and Mars missions N88-24377

MANNED ORBITAL LABORATORIES
Arguments for manned or unmanned spacecraft activities [REPT-46/87] N88-23813

MANNED SPACECRAFT
Arguments for manned or unmanned spacecraft activities [REPT-46/87] N88-23813

MANUALS
Advisory circular: Noise certification handbook [FAA-AC-36-4B] N88-24234

MANUFACTURING
Manufacturing requirements N88-23745
Preliminary aerodynamic design considerations for advanced laminar flow aircraft configurations N88-23746

MAPPING
A proposal for a project entitled assessment of forest resources in Uruguay submitted to the United Nations Industrial Development Organization (UNIDO) N88-24016
The geometric workstation, a new approach for geometric corrections of remotely sensed data N88-24017
Mapping from LANDSAT and SPOT satellite imagery N88-24018
Airborne and spaceborne radar images for geologic and environmental mapping in the Amazon rain forest, Brazil N88-24021
Mapping soil and rock variation from satellite images in the Sahel N88-24023
Remote sensing and data integration: Practical solutions for resource managers N88-24034
Utilization of TM/LANDSAT images in the implanted forests mapping in the Mogi-Guacu Region (SP-Brazil) N88-24042
CANASATE: Sugar cane mapping by satellite N88-24046
Structure and dynamics of vegetation in the middle semi-arid tropics. Quixaba's Caatinga (PE): Terrain analysis of MSS/LANDSAT data N88-24049
Study of fracturing for groundwater research in the Sergipe state with remote sensing products N88-24052
Implantation of a geo-cartographical information system through microcomputers N88-24064
Detection of biomass burning and smoke plumes in the Amazon region through NOAA satellite imagery N88-24085
The 35 mm vertical aerial photographs for mapping stands of bracatinga in different age classes N88-24087
The breaked anticlines, cuesta and crest homoclines, ortoclinal valleys, and other forms of relief outcrops delineated with the help of remote sensing imagery N88-24089
Current stage of remote sensing system for cartographic application N88-24090
Mapping of plant associations and the variation of surface water in the Pantanal Mato-Grossense National Park, through remote sensing techniques N88-24092
Characteristics of drainage determinations in aerial photographs and relief determination on different scales planialtimetric charts for three soils in the state of Sao Paulo N88-24095
Criteria for planimetric and altimetric correction of maps restituted from aerial photographs in 1:100,000 scale N88-24097
Geomorphologic sector maps of Niquizanga-Mayares, province of San Juan, Argentina N88-24098
Research on enhancing the utilization of digital multispectral data and geographic information systems in global habitability studies [NASA-CR-182799] N88-24101

MARINE ENVIRONMENTS
Corrosion of tungsten alloys in marine environments N88-23854

MARKOV PROCESSES
Experimental evaluation of algorithms for connected speech recognition using hidden Markov models
[RSRE-MEMO-4099] N88-23928
MARS (PLANET)
Engineering planetary lasers for interstellar communication
[NASA-CR-180780] N88-23825
Electromagnetic powered vehicles (EMPV) for Mars exploration N88-24388
Power requirements for mining and microwave processing of extraterrestrial resources N88-24389
MASS
The effect of maximum allowable payload temperature on the mass of a multimegawatt space based platform N88-24416
MACRAD: A mass analysis code for radiators N88-24418
Energy storage for nuclear burst power systems N88-24431
MASS TRANSFER
Studies of heat and mass transfer during chemical vapor deposition N88-23953
Thermochemical analysis of mass transfer in a NB-1ZR-potassium heat pipe N88-24346
Fabrication of a niobium 1 percent zirconium containment for SP-100 primary lithium system materials mass transfer studies N88-24373
MATERIALS HANDLING
Selection of a handling and maintenance option for the SP-100 ground engineering system test N88-24285
MATHEMATICAL MODELS
Propulsive performance of a lifting flapping wing N88-23733
Travelling wave concepts for the modeling and control of space structures
[AD-A191235] N88-23819
Preventing aircraft corrosion by predictive corrosion modeling N88-23863
Modeling, filtering and control of stochastic processes --- communication networks
[ENST-87E021] N88-23925
Numerical modelling of flows using phoenics N88-23955
Theory of neutron moisture probes and interpretation of measurements in complex soil and water systems N88-23965
Theoretical studies of solar-pumped lasers
[NASA-CR-182929] N88-23971
Parameter identification methods for improving structural dynamic models
[NASA-TM-100812] N88-23994
Three-dimensional curved shell and solid-shell transition finite elements with temperature and temperature gradients as primary variables for steady state heat conduction N88-23997
Navigation system from AVHRR data from NOAA series satellites N88-24054
Low altitude remote sensing data in the implementation of a mathematical model for the planning of urban equipment networks N88-24074
Visualization of digital terrain models N88-24081
Digital monoplotting, part 1
[B8735122-PT-1] N88-24106
Digital monoplotting, part 2
[B8735122-PT-2] N88-24107
An update on remote measurement of soil moisture over vegetation using infrared temperature measurements: A FIFE perspective
[NASA-CR-182926] N88-24109
Evaluation of a model of the Earth's gravity field
[EPSHOM-003/87] N88-24116
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125
Mathematical modelling of the heat and water vapour transport in the human respiratory tract N88-24160
Separability and security models --- software
[RSRE-87020] N88-24180
Adjusting a finite element model using vibration type experimental data. Concept and error detection
[ONERA-RT-7/3313-RY-060-R] N88-24220
A recursive prediction error parameter estimator for nonlinear models
[RR-326] N88-24222
On Hotelling's approach to testing for a nonlinear parameter in regression
[AD-A191189] N88-24229
A thermal equilibrium model for multi-megawatt space platforms N88-24332
Progress in the computer modeling of the liquid phase behavior of a liquid metal heat pipe N88-24342
A compressible vapor flux model for transient heat pipe analysis N88-24343
ATHENA heat pipe transient model N88-24344
Detailed transient model of a liquid-metal heat pipe N88-24345
Transient thermohydraulic heat pipe modeling N88-24347
RSMASS: A simple model for estimating reactor/shield masses N88-24355
SP-100 control system modeling N88-24356
Expert systems approach to modeling systems with the ATHENA thermal-hydraulics code N88-24365
A generalized method for optimizing the mass of space power systems N88-24369
Modeling of radiation dose dependence of MOSFETs N88-24370
SP-100 system modeling: SNPSAM update N88-24372
Microgravity two-phase fluid flow pattern modeling N88-24467
Experimental evaluation of the MIT-SNL period-generated minimum time control laws for the rapid adjustment of reactor power N88-24494
Consistent transport coefficients in astrophysics
[NASA-TM-101154] N88-24560
A model for the X-ray binary 4U1820-30
[NASA-TM-101143] N88-24562
The Jovian aurora: Electron or ion precipitation
[NASA-TM-101153] N88-24566
A benchmark for galactic cosmic ray transport codes
[NASA-TM-101157] N88-24571
MATRICES (MATHEMATICS)
Minimal parameter solution of the orthogonal matrix differential equation
[NASA-TM-4043] N88-24165
MAXIMUM LIKELIHOOD ESTIMATES
A comparison of supervised maximum likelihood and decision tree classification for crop cover estimation from multitemporal LANDSAT MSS data N88-24014
Generation of thematic maps for updating aeronautical pilot charts utilizing LANDSAT-TM images N88-24062
MEASURING INSTRUMENTS
Cylindrical surface profile and diameter measuring tool and method
[NASA-CASE-MFS-28287-1] N88-23959
Apparatus for the measurement of resistivity of glasses and ceramics N88-24460
MECHANICAL PROPERTIES
Travelling wave concepts for the modeling and control of space structures
[AD-A191235] N88-23819
Structural ceramics research N88-23878
Improved silicon carbide for advanced heat engines N88-23879
Improved silicon nitride for advanced heat engines N88-23881
Improved processing of Si3N4 N88-23882
Colloidal characterization of silicon nitride and silicon carbide N88-23883
SiC fiber analysis N88-23891
Improved GaP doped SiGe thermoelectric material N88-24503
MECHANICAL SHOCK
The Shock and Vibration Digest, volume 20, no. 4 N88-24214
MEDICAL EQUIPMENT
Low altitude remote sensing data in the implementation of a mathematical model for the planning of urban equipment networks N88-24074
MELTING
Microgravity thaw experiment (MITEX) N88-24439
MELTS (CRYSTAL GROWTH)
Real time thermal imaging of high temperature semiconductor melts N88-23914
MERCURY CADMIUM TELLURIDES
Compositional redistribution during casting of Hg sub 0.8 Cd sub 0.2 Te alloys
[NASA-TM-101151] N88-23893
Study for the determination of general and specific properties of wide energy-band gap HgCdTe in the 1 to 2 micrometer wavelength range
[AD-A191091] N88-23934
MESH
Fatigue failure of regenerator screens in a high frequency Stirling engine N88-24491
MESON RESONANCE
Search for bound states of the eta-meson in light nuclei N88-24248
MESONS
Search for bound states of the eta-meson in light nuclei N88-24248
METAL BONDING
Composite piston
[NASA-CASE-LAR-13435-1] N88-23981
METAL COATINGS
Recent advances in metallic/ceramic coatings for corrosion control in military applications N88-23858
Vanadic hot corrosion of gas turbine blade coating materials N88-23864
Development of reliable fuel pins for space reactor applications N88-24326
METAL FATIGUE
AC impedance analysis of corrosion fatigue in naval aircraft alloys
[AD-A190822] N88-23865
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428
METAL HYDRIDES
Materials science with muon spin rotation
[NASA-CR-182891] N88-24242
Muon motion in titanium hydride N88-24247
METAL IONS
Ion beam alloying of aluminum for corrosion resistance N88-23860
Complexation and hydrolysis reactions of iron(III) N88-23867
METAL MATRIX COMPOSITES
Structure and mechanical properties of metal matrix composites made using semi-solid processes: The case of the system Al-Si/SiC
[ETN-88-92299] N88-23836
Strain intensity factor approach for predicting the strength of continuously reinforced metal matrix composites
[NASA-TM-100617] N88-23838
METAL OXIDE SEMICONDUCTORS
The effect of elevated temperature on irradiated MOS devices N88-24308
METAL SHEETS
Weldability of general purpose heat source iridium capsules N88-24429
METAL SURFACES
Enhanced emittance of oxidized 304 stainless steel N88-24408
METAL-GAS SYSTEMS
Studies for the definition of a Faraday converter for space nuclear systems N88-24339
METALLIC GLASSES
Corrosion and fatigue properties of FeCrB/Si metallic glass wires in aqueous environments N88-23855
METALS
Friction and wear of ceramics N88-23874
Noncontact temperature measurement: Requirements and applications for metals and alloys research N88-23899
METEORITIC DAMAGE
A review of impact design criteria for space power heat rejection systems N88-24333
METEOROID PROTECTION
A review of impact design criteria for space power heat rejection systems N88-24333
METEOROLOGICAL SATELLITES
Meteorological Satellite Center Technical Note No. 16
[ISSN-0388-9653] N88-24003
Prospects of satellite wind sensing systems in the years 1995-2000 N88-24004
Outline of the GPCP strategy N88-24007
VISSR line number monitoring system N88-24008
METEOSAT SATELLITE
Presentation of the METEOSAT system and the roles of EUMETSAT within the meteorological community N88-24039
METHANE
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125
METHYL ALCOHOL
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844
METHYL COMPOUNDS
Corrosion and corrosion inhibition of metals/alloys in methyphosphonic difluoride N88-23850
Modification of polymers by photografting processes N88-23871
MICROBURSTS (METEOROLOGY)
Flight penetration of wind shear: Control strategies N88-23727
MICROCOMPUTERS
DATAC bus monitor N88-23721
Implantation of a geo-cartographical information system through microcomputers N88-24064
MICROELECTRONICS
Microelectronics the next fifteen years N88-23792
MICROMETEOROLOGY
An update on remote measurement of soil moisture over vegetation using infrared temperature measurements: A FIFE perspective
[NASA-CR-182926] N88-24109
MICROPROCESSORS
SP-100 ground engineering systems test facility control systems N88-24496
MICROSTRUCTURE
Structure and mechanical properties of metal matrix composites made using semi-solid processes: The case of the system Al-Si/SiC
[ETN-88-92299] N88-23836
Improved processing of Si3N4 N88-23882

Fractographic and microstructural evaluation of 3500-hour durability specimens N88-23887
The role of oxygen on the mechanical behavior of molybdenum alloys N88-24278

MICROWAVE LANDING SYSTEMS
Development of an airborne facility for advanced avionics research N88-23801

MICROWAVES
Power requirements for mining and microwave processing of extraterrestrial resources N88-24389

MIDAIR COLLISIONS
UK airmiss statistics
[CAA-1/87] N88-23761

MIDDLE ATMOSPHERE
Finite element simulation of the atmosphere's electromagnetic response to charge perturbations associated with lightning N88-24124

MILITARY HELICOPTERS
Test philosophy of the EH101 integrated avionic N88-23775
Operation and performance of an integrated helicopter communication system N88-23787

MILITARY SPACECRAFT
Air Force space power requirements and nuclear power assessment methodology N88-24378
Comparison of a direct thrust nuclear engine, nuclear electric engine and a chemical engine for future space missions N88-24379

MILLIMETER WAVES
Operation and performance of an integrated helicopter communication system N88-23787

MINERAL EXPLORATION
An integrated study of the Alto Paranaiba Kimberlite Province, Minas Gerais, Brazil: A possible tool for diamond exploration N88-24031
Lithostructural interpretation of Chapda do Cachimbo (Pa-Am-Mt), based on radar and LANDSAT imagery N88-24100

MINES
Criteria for planimetric and altimetric correction of maps restituted from aerial photographs in 1:100,000 scale N88-24097

MINES (EXCAVATIONS)
Mining volume measurement system
[NASA-CASE-LAR-13519-1] N88-23963

MINIATURIZATION
Miniature traveling wave tube and method of making
[NASA-CASE-LEW-14520-1] N88-23936

MINING
Power requirements for mining and microwave processing of extraterrestrial resources N88-24389
Energy requirements for HE-3 mining operations on the Moon N88-24390

MIRAGE AIRCRAFT
Testing complex avionics software: A practical experience N88-23794
Development of complex avionics systems: Experience from French military programs N88-23804

MIRROR FUSION
SOAR: Space orbiting advanced fusion power reactor N88-24366

MISSILE DEFENSE
Free electron lasers in strategic defense
[DE88-007024] N88-24231

MISSION PLANNING
Civil missions applications study N88-24376

MOBILE COMMUNICATION SYSTEMS
MSAT-X: A technical introduction and status report
[NASA-CR-182921] N88-23933

MOBILITY
Examples of ice pack rigidity and mobility characteristics determined from ice motion
[AD-A191163] N88-24129

MODAL RESPONSE
Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness
[NASA-TP-2697] N88-23988

MODELS
Flight testing a V/STOL aircraft to identify a full-envelope aerodynamic model
[NASA-TM-100996] N88-23782
The Systeme d'Analyse Geographique (SAGE) geographic analysis system N88-24019
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24026
Three-dimensional models of conventional and vertical junction laser-photovoltaic energy converters
[NASA-TM-4039] N88-24111
Models and metrics for software management and engineering
[NASA-CR-182953] N88-24200
Induction of models under uncertainty
[NASA-TM-101173] N88-24230
Analytical modeling of the structureborne noise path on a small twin-engine aircraft
[NASA-CR-4136] N88-24233
Hydrogen turbines for space power systems: A simplified axial flow gas turbine model N88-24385
A transient model for liquid metal heat pipes N88-24398
Analysis of dust grain properties in two star forming regions through comparison of theoretical models to observations N88-24559

MODERATION (ENERGY ABSORPTION)
Particle bed reactor scaling relationships N88-24267

MODULARITY
Status of modular RTG technology N88-24403

MODULATION
Doppler radar with multiphase modulation of transmitted and reflected signal
[NASA-CASE-MSC-18808-1] N88-23923
Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness
[NASA-TP-2697] N88-23988

MODULES
Systems for the 21st century N88-23769
Design for interoperability (interchangeability) N88-23789

MOLECULAR BEAM EPITAXY
Microelectronics the next fifteen years N88-23792

MOLECULAR BIOLOGY
ECUT (Energy Conversion and Utilization Technologies) program: Biocatalysis Project
[NASA-CR-182917] N88-24110

MOLECULAR CLOUDS
Analysis of dust grain properties in two star forming regions through comparison of theoretical models to observations N88-24559

MOLECULAR EXCITATION
Experiments on reactions of the electronically excited molecule nitron NH (a sup 1 delta) and carbon CH2 (a bar sup 1 A(1)) in gas phase
[MPIS-3/1987] N88-24249

MOLECULAR GASES
Molecular gas in Virgo cluster spiral galaxies N88-24557

MOLECULAR STRUCTURE
Disclination structures in carbon and graphite
[AD-A191056] N88-23868

MOLYBDENUM
AMTEC electrode development N88-24324

MOLYBDENUM ALLOYS
The role of oxygen on the mechanical behavior of molybdenum alloys N88-24278

MOMENTUM
Inflation in Einstein-Cartan theory with energy-momentum tensor with spin
[NASA-TM-101164] N88-24547

MONATOMIC GASES
Total photoionization cross sections of atomic oxygen from threshold to 44.3A
[NASA-CR-182992] N88-24252

MONITORS
DATAC bus monitor N88-23721
Television monitor field shifter and an opto-electronic method for obtaining a stereo image of optimal depth resolution and reduced depth distrotion on a single screen
[NASA-CASE-NPO-17249-1-CU] N88-23924
TES: A modular systems approach to expert system development for real-time space applications N88-24197

MONOCHROMATORS
Intensity calibration of a VUV system by branching line pairs N88-24533

MONTE CARLO METHOD
Monte Carlo analysis of lateral collection diode arrays
[RSRE-MEMO-4080] N88-23938

MORPHOLOGY
Study of fracturing for groundwater research in the Sergipe state with remote sensing products N88-24052
Dune fields in central Western Argentina N88-24088
Molecular gas in Virgo cluster spiral galaxies N88-24557

MOTION PERCEPTION
Designing for design effectiveness of complex avionics systems N88-23788

MULTIPOLES
On the efficient implementation of the fast multipole algorithm
[AD-A191167] N88-24173

MULTISPECTRAL PHOTOGRAPHY
Study of methods of post-processing applied to a problem of standard classification N88-24067

MULTIVARIATE STATISTICAL ANALYSIS
Improved estimators in simultaneous estimation of scale parameters
[AD-A191108] N88-24216
Almost sure L(gamma)-norm convergence for data-based histogram density estimates
[AD-A189944] N88-24228

MUON SPIN ROTATION
Materials science with muon spin rotation
[NASA-CR-182891] N88-24242
Systematic variation of magnetic-field penetration depth in high-T(c) superconductors studied by muon spin relaxation N88-24243
Comparison between muon spin rotation and neutron scattering studies on the 3-dimensional magnetic ordering of La2CuO(4-y) N88-24244
Coexisting static magnetic ordering and superconductivity in CeCu2.1Si2 found by muon spin relaxation N88-24245
Static magnetic ordering of CeCu2.1Si2 found by muon spin relaxation N88-24246
Muon motion in titanium hydride N88-24247

MUONS
Muon motion in titanium hydride N88-24247

MUSCLES
Activation, strength and endurance of human respiratory and limb muscles N88-24158

MUSCULAR FATIGUE
Activation, strength and endurance of human respiratory and limb muscles N88-24158

MUSCULAR FUNCTION
Activation, strength and endurance of human respiratory and limb muscles N88-24158

MUSCULAR STRENGTH
Activation, strength and endurance of human respiratory and limb muscles N88-24158

N

N-P-N JUNCTIONS
Neutron effects on the electrical and switching characteristics of NPN bipolar power transistors N88-24463

NASA PROGRAMS
PAN AIR analysis of the NASA/MCAIR 279-3: An advanced supersonic V/STOL fighter/attack aircraft
[NASA-TM-86838] N88-23750
Structural ceramics research N88-23878
Structures and Dynamics Division research and technology plans for FY 1988 and accomplishments for FY 1987
[NASA-TM-100585] N88-24000

NAUTICAL CHARTS
Generation of thematic maps for updating aeronautical pilot charts utilizing LANDSAT-TM images N88-24062

NAVIER-STOKES EQUATION
Numerical simulation of scramjet inlet flow fields
[NASA-TP-2517] N88-23735
An efficient parallel algorithm for the simulation of three-dimensional compressible transition on a 20 processor Flex/32 multicomputer
[NASA-CR-178340] N88-23943

NAVIGATION AIDS
Refraction in underwater acoustics --- navigation systems
[B8735053] N88-24236

NETWORK CONTROL
Modeling, filtering and control of stochastic processes --- communication networks
[ENST-87E021] N88-23925

NEURAL NETS
Genetic algorithms for adaptive real-time control in space systems N88-24195

NEUROMUSCULAR TRANSMISSION
Evaluation of the endogenous glucocorticoid hypothesis of denervation atrophy
[NASA-CR-182848] N88-24157

NEUTRAL ATOMS
Flux density measurements of neutral iron in TEXTOR with laser induced fluorescence N88-24528

NEUTRAL BEAMS
Power source selection for neutral particle beam systems N88-24314
Ion temperature profile measurement using charge exchange recombination spectroscopy on JIPP T-IIU N88-24518
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D N88-24519

NEUTRON ABSORBERS
Fabrication of lithium hydride shields for space nuclear power systems N88-24282

NEUTRON BEAMS
Interaction of slow neutrons with Ge74 single crystals
[DE87-703010] N88-24536

NEUTRON CROSS SECTIONS
Effects of space-dependent cross sections on core physics parameters for compact fast spectrum space power reactors N88-24263

NEUTRON DIFFRACTION
The structural analysis of some crystalline and semi-crystalline substances using X-ray and neutron diffraction N88-24540
NEUTRON FLUX DENSITY
Application of the reactivity constraint approach to the transient control of spacecraft reactors N88-24305
NEUTRON IRRADIATION
Material tradeoffs to minimize flooding reactivity N88-24265
Neutron radiation tolerance of Au-activated silicon N88-24316
Defects in cubic silicon carbide on silicon N88-24317
Point defects in irradiated silicates N88-24319
MMW shielding design and analysis N88-24457
Neutron effects on the electrical and switching characteristics of NPN bipolar power transistors N88-24463
Development of refractory thermocouples for space nuclear power tests N88-24478
NEUTRON SCATTERING
Theory of neutron moisture probes and interpretation of measurements in complex soil and water systems N88-23965
Comparison between muon spin rotation and neutron scattering studies on the 3-dimensional magnetic ordering of La2CuO(4-y) N88-24244
NEUTRON STARS
Quark core stars, quark stars and strange stars [DE88-006991] N88-24555
A model for the X-ray binary 4U1820-30 [NASA-TM-101143] N88-24562
Spectral modelling of the soft gamma ray repeater [DE88-007027] N88-24570
NEW MEXICO
Transactions of the Fifth Symposium on Space Nuclear Power Systems [DE88-006165] N88-24374
NEWTON THEORY
Non-Newtonian gravity or gravity anomalies? [NASA-TM-4030] N88-24116
NICKEL CADMIUM BATTERIES
Aerospace energy systems laboratory: Requirements and design approach [NASA-TM-100423] N88-24206
NIOBIUM
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites N88-24427
NIOBIUM ALLOYS
Preliminary study of niobium alloy contamination by transport through helium N88-24279
Fabrication of a niobium 1 percent zirconium containment for SP-100 primary lithium system materials mass transfer studies N88-24373
NIOBIUM COMPOUNDS
Method of producing high T(subc) superconducting NBN films [NASA-CASE-NPO-16681-1-CU] N88-24543
NITRIDES
Uranium nitride fuel swelling and thermal conductivity correlations N88-24327
An irradiation performance data base for nitride fuels N88-24438
Material property and irradiation performance correlations for nitride fuels N88-24483
A comparison of uranium nitride and mixed carbide fuels swelling N88-24485
Method of producing high T(subc) superconducting NBN films [NASA-CASE-NPO-16681-1-CU] N88-24543
NITRIDING
SiC fiber reinforced reaction-bonded Si3N4 composites N88-23892
NITROGEN HYDRIDES
Experiments on reactions of the electronically excited molecule nitron NH (a sup 1 delta) and carbon CH2 (a bar sup 1 A(1)) in gas phase [MPIS-3/1987] N88-24249
NOAA SATELLITES
Processing of HRPT data from the NOAA series satellites N88-24053
NOISE MEASUREMENT
Advisory circular: Noise certification handbook [FAA-AC-36-4B] N88-24234
NOISE REDUCTION
The calculation of casually constrained optima in the active control of sound [ISVR-TR-147] N88-24237
NONDESTRUCTIVE TESTS
Structural Ceramics [NASA-CP-2427] N88-23872
Nondestructive evaluation of structural ceramics N88-23876
Nondestructive Evaluation (NDE) of structural ceramics by photoacoustic microscopy N88-23884
Acoustic emission frequency discrimination [NASA-CASE-MSC-20467-1] N88-23966
Method of radiographic inspection of wooden members [NASA-CASE-LAR-13724-1] N88-23983
Input-output characterization of fiber composites by SH waves [NASA-CR-4153] N88-23986
Characterization of noncontact piezoelectric transducer with conically shaped piezoelement [NASA-CR-4151] N88-23987
NONLINEAR OPTICS
Enhancement of second harmonic generation on silver gratings by resonant excitation of surface plasmon [ETN-88-92304] N88-24509
NONLINEAR SYSTEMS
Parallel processors and nonlinear structural dynamics algorithms and software [NASA-CR-182925] N88-24187
A recursive prediction error parameter estimator for nonlinear models [RR-326] N88-24222
NONLINEARITY
Electromagnetic scattering from nonlinear anisotropic cylinders N88-23930
On Hotelling's approach to testing for a nonlinear parameter in regression [AD-A191189] N88-24229
NOZZLE EFFICIENCY
Aeropropulsive characteristics of isolated combined turbojet/ramjet nozzles at Mach numbers from 0 to 1.20 [NASA-TP-2814] N88-23757
NOZZLE FLOW
Tests on oscillating flows in a pipe nozzle with an abrupt diameter variation [MPIS-2/1987] N88-23947
NOZZLE GEOMETRY
Aeropropulsive characteristics of isolated combined turbojet/ramjet nozzles at Mach numbers from 0 to 1.20 [NASA-TP-2814] N88-23757
NUCLEAR ELECTRIC POWER GENERATION
Benefits of 20 kHz PMAD in a nuclear space station N88-24256
Nuclear electric power for multimegawatt orbit transfer vehicles N88-24261
NUCLEAR ELECTRIC PROPULSION
Nuclear electric propulsion system: Nuclear plant and thermomechanical conversion system N88-24298
Comparison of a direct thrust nuclear engine, nuclear electric engine and a chemical engine for future space missions N88-24379
NUCLEAR ENGINE FOR ROCKET VEHICLES
History of some direct nuclear propulsion developments since 1948 N88-24270
A critique of NERVA based nuclear reactor design and performance for MMW space propulsion applications N88-24297
Nuclear propulsion: Past, present and future N88-24441
The NERVA derivative reactor and a systematic approach to multiple space power requirements N88-24458
NUCLEAR FISSION
Space based nuclear-pumped laser/reactor concepts N88-24289
NUCLEAR FUEL ELEMENTS
Material tradeoffs to minimize flooding reactivity N88-24265
Particle bed reactor scaling relationships N88-24267
Irradiation test results on thermionic fuel element sheath insulators N88-24280
Development of reliable fuel pins for space reactor applications N88-24326
A review of diffusion barrier technology for application in SP-100 fuel pins N88-24328
Evaluation of UN fuel pin failure modes and motion of fuel during severe accidents for reactors in space N88-24424
Research and development of electrical insulators for thermionic applications N88-24449
SNAP fuel performance N88-24484
NUCLEAR FUELS
Fully passive space reactor conceptual design N88-24288
Uranium nitride fuel swelling and thermal conductivity correlations N88-24327
Helium-3 fusion fuel resources for space power N88-24330
Fabrication of SP-100 fuel barrier structures by chemical vapor deposition N88-24371
Critical nuclear launch issues: A perspective from the State of Florida N88-24412
A novel plant protection strategy for transient reactors N88-24423
Evaluation of UN fuel pin failure modes and motion of fuel during severe accidents for reactors in space N88-24424
Weldability of general purpose heat source iridium capsules N88-24429
An irradiation performance data base for nitride fuels N88-24438
A high power density radial-in-flow reactor split core design for space power systems N88-24455
Molybdenum-base cermet fuel development N88-24481
Test plan and facilities for qualifying nuclear rocket fuel elements N88-24482
Material property and irradiation performance correlations for nitride fuels N88-24483
SNAP fuel performance N88-24484
A comparison of uranium nitride and mixed carbide fuels swelling N88-24485
NUCLEAR FUSION
Helium-3 fusion fuel resources for space power N88-24330
NUCLEAR POWER PLANTS
Nuclear electric propulsion system: Nuclear plant and thermomechanical conversion system N88-24298
Thermal management for multi-modal nuclear power plants N88-24331
NUCLEAR POWER REACTORS
Operational concerns involving a shadow-shielded nuclear reactor for space station applications N88-24257
Nuclear electric power for multimegawatt orbit transfer vehicles N88-24261
Gigawatt, closed cycle, vapor core-MHD space power system conceptual design study N88-24473
Critical issues for SOAR: The space orbiting advanced fusion power reactor N88-24474
Comparison of 20-kWe space nuclear power systems: Impact of reactor temperature and technology upon system design and performances N88-24475
Potassium Rankine power system for space power N88-24476
Low cross-section Mo-Nb thermocouples for nuclear application: The state-of-the-art N88-24477
Material property and irradiation performance correlations for nitride fuels N88-24483
NUCLEAR PROPULSION
Nuclear electric power for multimegawatt orbit transfer vehicles N88-24261
History of some direct nuclear propulsion developments since 1946 N88-24270
Direct nuclear propulsion for Earth-to-orbit vehicles N88-24271
Nuclear propulsion systems for orbit transfer based on the particle bed reactor N88-24272
Ultra high temperature direct propulsion N88-24275
Safety constraints and considerations in the development of nuclear powered propulsion N88-24276
Comparison of a direct thrust nuclear engine, nuclear electric engine and a chemical engine for future space missions N88-24379
Nuclear propulsion: Past, present and future N88-24441
Gas core reactors for direct nuclear propulsion N88-24442
Noncryogenic propellants for a nuclear orbit transfer vehicle N88-24444
NUCLEAR REACTIONS
Search for bound states of the eta-meson in light nuclei N88-24248
NUCLEAR REACTOR CONTROL
Application of the reactivity constraint approach to the transient control of spacecraft reactors N88-24305
Reactor instrumentation and control design and performance simulation for SP-100 N88-24306
An adaptive load-following control system for a space nuclear power system N88-24307
Benchmark physics experiments for SP-100 N88-24453
A high power density radial-in-flow reactor split core design for space power systems N88-24455
Transient analyses of multimegawatt space reactors N88-24456
Silicon-on-insulator electronics for a space nuclear power system N88-24461
NUCLEAR REACTORS
Requirements and cost considerations for a combined space nuclear reactor test facility N88-24277
The role of integral experiments and nuclear cross section evaluations in space nuclear reactor design N88-24293
Nuclear reactor magnetohydrodynamic power generator for directed energy weapons N88-24336
EETAP (End-to-End Transient Analysis Program) for space nuclear power system simulation N88-24381

Relating design and environmental variables to reliability N88-24383
Theoretical prediction of single phase turbulent flow distribution in particulate bed reactors N88-24386
Monolithic fuel cell based power source for burst power generation N88-24450
High power density alkaline fuel cell technology for MMW space burst power N88-24451

NUCLEAR RESEARCH AND TEST REACTORS
Radiation effects testing capabilities of the Texas A and M Nuclear Science Center N88-24368

NUCLEAR ROCKET ENGINES
TRICE design, evaluation and feasibility tests N88-24498

NUCLEATE BOILING
Nucleate pool boiling: High gravity to reduced gravity; liquid metals to cryogens N88-24484

NUCLEI (NUCLEAR PHYSICS)
Search for bound states of the eta-meson in light nuclei N88-24248

NUMBER THEORY
On a classification of problems on sets of bilinear forms by formal polynomials
[RR-642-I-IMAG-53-LIFIA] N88-24219

NUMERICAL ANALYSIS
Unsteady flow about cambered plates
[AD-A191226] N88-23945
Activities of the Institute for Computer Applications in Science and Engineering (ICASE)
[NASA-CR-181666] N88-24166
Scientific computing environments
[AD-A191239] N88-24175
Consistent transport coefficients in astrophysics
[NASA-TM-101154] N88-24560

NUMERICAL CONTROL
A timing evaluator for C programs generated by the model system
[AD-A191204] N88-24174

NUMERICAL FLOW VISUALIZATION
Efficient implementation of essentially non-oscillatory shock capturing schemes, 2
[NASA-CR-181656] N88-24217

NUTRITIONAL REQUIREMENTS
Botany Facility: Problems of water supply, plant nutrients and soil in the Botany Facility
[SIRA-A/7373/WP220/RJS/003] N88-24141
Supply and distribution of plant nutrients in the Botany Facility
[SIRA-A/7373/WP220/RJS/004] N88-24142

O

OBJECT PROGRAMS
Mentat: An object-oriented macro data flow system
[NASA-TM-101165] N88-24199

OCCULTATION
Manual for obscuration code with space station applications
[NASA-CR-178099] N88-23931

OCEAN CURRENTS
Near surface current determined from INPE's satellite-tracked buoy, during 6-26 November, 1985 N88-24058

OCEANOGRAPHIC PARAMETERS
ERS-1 data products and services and their value for tropical countries N88-24040

OCEANOGRAPHY
Research and Technology, 1987, Goddard Space Flight Center N88-24572

OIL ADDITIVES
The performance of perfluoropolyalkylether oils under boundary lubrication conditions
[AD-A191057] N88-23869

OILS
Boundary layer flow visualization for flight testing N88-23742

ONBOARD EQUIPMENT
Systems for the 21st century N88-23769
On-orbit technology experiment facility definition
[NASA-TM-100614] N88-23824

OPERATING TEMPERATURE
The effect of operating temperature on open, multimegawatt space power systems N88-24352
The effect of operating temperature and turbine blade cooling on Brayton cycle space power systems N88-24489

OPERATOR PERFORMANCE
Spatial cognition N88-24152
Teleoperator human factors study
[NASA-CR-178930] N88-24162

OPERATORS (MATHEMATICS)
On the efficient implementation of the fast multipole algorithm
[AD-A191167] N88-24173

OPTICAL COMMUNICATION
Engineering planetary lasers for interstellar communication
[NASA-CR-180780] N88-23825
Interaction of solitons in single model optical fibres N88-24511

OPTICAL DATA PROCESSING
Sky radiance distributions for thermal imaging backgrounds
[AD-A191135] N88-24115

OPTICAL FIBERS
Interaction of solitons in single model optical fibres N88-24511

OPTICAL MEASUREMENT
Air Force ultrafast optical electronics center
[AD-A191491] N88-24507
Measurements of Z(sub eff) profile with a visible bremsstrahlung continuum detector array N88-24529

OPTICAL PROPERTIES
Air Force ultrafast optical electronics center
[AD-A191491] N88-24507

OPTICAL PYROMETERS
Noncontact Temperature Measurement
[NASA-CP-2503] N88-23895
Direct emissivity measurements on liquids and corrections to multi-color pyrometers N88-23906
Common but unappreciated sources of error in one, two, and multiple-color pyrometry N88-23907
Fast optical pyrometry N88-23908

OPTICAL RESONANCE
Enhancement of second harmonic generation on silver gratings by resonant excitation of surface plasmon
[ETN-88-92304] N88-24509

OPTICAL WAVEGUIDES
Monolithic integration on a GaAs substrate of a quarter ring laser and an optical guide coupled by an evanescent wave
[ETN-88-92308] N88-23969

OPTIMAL CONTROL
An algorithm for super-optimal H sup inf design: The 2-block case
[OUEL-1711/87] N88-24210
A state-space approach to discrete-time super-optimal H sup inf control problems
[OUEL-1712/87] N88-24211
Energy optimal trajectory planning for robot manipulators and autonomous vehicles N88-24497

OPTIMIZATION
Sensitivity analysis and multidisciplinary optimization for aircraft design: Recent advances and results
[NASA-TM-100630] N88-23766
A generalized method for optimizing the mass of space power systems N88-24369
Optimization of SP-100 thermoelectric electromagnetic pump N88-24382
Optimization of organic Rankine cycles for space station applications N88-24407
Small particle bed reactors: Sensitivity to Brayton cycle parameters N88-24487
Energy conversion system optimization study for multimegawatt space nuclear power application N88-24492
Superconducting thin film vertex detector for SSC (Superconducting Super Collider) applications
[DE88-005951] N88-24535

OPTOELECTRONIC DEVICES
Television monitor field shifter and an opto-electronic method for obtaining a stereo image of optimal depth resolution and reduced depth distortion on a single screen
[NASA-CASE-NPO-17249-1-CU] N88-23924

ORBIT DECAY
The prediction of satellite lifetimes
[RAE-TR-87030] N88-23818

ORBIT TRANSFER VEHICLES
Nuclear electric power for multimegawatt orbit transfer vehicles N88-24261
Analysis of a nuclear orbital transfer vehicle reentry accident N88-24426
Noncryogenic propellants for a nuclear orbit transfer vehicle N88-24444
Solar thermal propulsion for orbit transfer vehicles N88-24445

ORBITAL ASSEMBLY
Space spider crane
[NASA-CASE-LAR-13411-1-SB] N88-23828
Bi-stem gripping apparatus
[NASA-CASE-MFS-28185-1] N88-23979

ORBITAL LAUNCHING
Interplanetary propulsion using inertial fusion N88-24273

ORBITAL LIFETIME
The prediction of satellite lifetimes
[RAE-TR-87030] N88-23818

ORBITAL MECHANICS
A generic multibody simulation
[NASA-CR-182949] N88-24198
Stochasticity in elliptical galaxies
[SER-C-PREPUBL-FASC-20] N88-24556

ORCHARDS
Preliminary study on the application of digital processing of TM-LANDSAT data in the mapping of apple orchards in Fraiburgo (SC) N88-24093

ORTHOGONAL FUNCTIONS
Minimal parameter solution of the orthogonal matrix differential equation
[NASA-TM-4043] N88-24165

ORTHOTROPIC PLATES
A generalized variational method for solving stress intensity factors at cracks on the edge of holes in orthotropic plates
[IC-AERO-87-02] N88-23992

OSCILLATING FLOW
Tests on oscillating flows in a pipe nozzle with an abrupt diameter variation
[MPIS-2/1987] N88-23947

OSCILLATIONS
Efficient implementation of essentially non-oscillatory shock capturing schemes, 2
[NASA-CR-181656] N88-24217

OSMIUM
Johnson noise thermometer for high-radiation and high-temperature environments N88-24480

OXIDATION
Enhanced emittance of oxidized 304 stainless steel N88-24408

OXIDATION RESISTANCE
Recent advances in metallic/ceramic coatings for corrosion control in military applications N88-23858

OXIDES
Thermal and power availability transient responses for the Argonne monolithic solid oxide fuel cell N88-24384

OXYGEN
Total photoionization cross sections of atomic oxygen from threshold to 44.3A
[NASA-CR-182992] N88-24252
The role of oxygen on the mechanical behavior of molybdenum alloys N88-24278

OZONE
The gamma 1 and gamma 3 bands of (16)O3: Line positions and intensities
[NASA-TM-101162] N88-24541
Line positions and intensities for the gamma 1 + gamma 2 and gamma 2 + gamma 3 bands of (16)O3
[NASA-TM-101161] N88-24542

OZONE DEPLETION
The potential impact on atmospheric ozone and temperature of increasing trace gas concentrations
[NASA-CR-182965] N88-24112

OZONOSPHERE
The potential impact on atmospheric ozone and temperature of increasing trace gas concentrations
[NASA-CR-182965] N88-24112

P

PAINTS
Development of microencapsulated DNBM quaternary ammonium inhibitors for paints N88-23851

PANELS
Operational considerations for laminar flow aircraft N88-23748

PARALLEL PROCESSING (COMPUTERS)
An efficient parallel algorithm for the simulation of three-dimensional compressible transition on a 20 processor Flex/32 multicomputer
[NASA-CR-178340] N88-23943
Evolution of a family of image processing systems at INPE N88-24065
Parallel processors and nonlinear structural dynamics algorithms and software
[NASA-CR-182925] N88-24187
Parallel discrete-event simulation of FCFS stochastic queueing networks
[NASA-CR-181669] N88-24203

PARAMETER IDENTIFICATION
Control law parameterization for an aeroelastic wind-tunnel model equipped with an active roll control system and comparison with experiment
[NASA-TM-100593] N88-23807
Parameter estimation for boundary value problems by integral equations of the second kind
[NASA-CR-181660] N88-23918
Parameter identification methods for improving structural dynamic models
[NASA-TM-100812] N88-23994
Estimation of time- and state-dependent delays and other parameters in functional differential equations
[NASA-CR-181683] N88-24164

Minimal parameter solution of the orthogonal matrix differential equation
[NASA-TM-4043] N88-24165
Application of spline functions to digital image processing
[ETN-88-92194] N88-24218
A recursive prediction error parameter estimator for nonlinear models
[RR-326] N88-24222

PARAMETERIZATION
Digital monoplotting, part 2
[B8735122-PT-2] N88-24107
The liquid droplet radiator in space: A parametric approach N88-24437

PARKS
Temporal analysis of the changes in Parque Estadual de Jacupiranga vegetation through digital treatment of LANDSAT imagery N88-24094

PARTICLE COLLISIONS
Ion generator and ion application system
[NASA-CASE-MFS-28122-1] N88-24253

PARTICLE DIFFUSION
Observation of injected silicon in heliotron E N88-24524

PARTICLE INTERACTIONS
Quark core stars, quark stars and strange stars
[DE88-006991] N88-24555

PARTICLE MOTION
Muon motion in titanium hydride N88-24247

PARTICLE PRECIPITATION
The precipitation of energetic heavy ions into the upper atmosphere of Jupiter
[NASA-TM-101155] N88-24565

PARTICLE PRODUCTION
Subthreshold pion production in proton induced reactions at 180 to 201 MeV and He3 at 283 MeV
[ETN-88-92303] N88-24250

PARTICLE SIZE DISTRIBUTION
Method of evaporation
[NASA-CASE-NPO-15609-2] N88-23846

PARTICLE TRAJECTORIES
Studies of heat and mass transfer during chemical vapor deposition N88-23953
Centrifugal acceleration of ions in the polar magnetosphere
[NASA-TM-101148] N88-24120

PARTICLES
On the efficient implementation of the fast multipole algorithm
[AD-A191167] N88-24173

PARTICULATES
Theoretical prediction of single phase turbulent flow distribution in particulate bed reactors N88-24386

PATTERN RECOGNITION
Generic cueing in image understanding
[RSRE-MEMO-4109] N88-24181

PATTERN REGISTRATION
The modeling of error budget analysis and tolerance specifications for BRESEX multiband linear array CCD camera N88-24029
Automatic registration of satellite imagery N88-24080

PAYLOAD DELIVERY (STS)
Noncryogenic propellants for a nuclear orbit transfer vehicle N88-24444

PAYLOAD INTEGRATION
Space nuclear reactor shielding optimization studies N88-24320
Turbomachinery in space N88-24321

PAYLOADS
ERS-1 data products and services and their value for tropical countries N88-24040
The effect of maximum allowable payload temperature on the mass of a multimegawatt space based platform N88-24416

PEBBLE BED REACTORS
Thermal-hydraulic considerations for particle bed reactors N88-24266
Particle bed reactor scaling relationships N88-24267
Direct nuclear propulsion for Earth-to-orbit vehicles N88-24271
Nuclear propulsion systems for orbit transfer based on the particle bed reactor N88-24272
Ultra high temperature direct propulsion N88-24275
Small particle bed reactors: Sensitivity to Brayton cycle parameters N88-24487
The closed Brayton cycle: An energy conversion system for near-term military space missions N88-24488
Energy conversion system optimization study for multimegawatt space nuclear power application N88-24492

PELLETS
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844

PENETRATION
Subsurface morphology and geoarchaeology revealed by spaceborne and airborne radar N88-24022

PERFLUORO COMPOUNDS
The performance of perfluoropolyalkylether oils under boundary lubrication conditions
[AD-A191057] N88-23869
Theoretical studies of solar lasers and converters
[NASA-CR-182927] N88-23972

PERFORATED PLATES
Operational considerations for laminar flow aircraft N88-23748

PERFORMANCE
Preliminary analysis of helium generation and its effects on the SP-100 system performance N88-24406

PERFORMANCE TESTS
Test philosophy of the EH101 integrated avionic N88-23775
Testing complex avionics software: A practical experience N88-23794
Error control techniques for satellite and space communications
[NASA-CR-182886] N88-23922
Botany Facility. Thermal Control (TC) subsystem test report on experiment container of laboratory model and breadboard centrifuge
[BF-TN-ER-061/86] N88-24135
Botany Facility: Test report on breadboard tests for the determination of the heat transfer at the glass disk and of the temperature distribution in the fluorescent tube
[BF-TN-ER-053] N88-24136
SP-100 GES test site N88-24375
Development of refractory thermocouples for space nuclear power tests N88-24478
SNAP fuel performance N88-24484

PERIDOTITE
An integrated study of the Alto Paranaiba Kimberlite Province, Minas Gerais, Brazil: A possible tool for diamond exploration N88-24031

PERIODIC VARIATIONS
Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness
[NASA-TP-2697] N88-23988

PERMEABILITY
Study of fracturing for groundwater research in the Sergipe state with remote sensing products N88-24052

PERSONAL COMPUTERS
Practical image analysis using personal computers: The Canadian experience N88-24037

PERTURBATION
Development and improvement of a code to calculate small, three dimensional, unsteady transonic perturbations
[ONERA-RTS-31/3064-RY-062-R] N88-23951
Finite element simulation of the atmosphere's electromagnetic response to charge perturbations associated with lightning N88-24124

PERTURBATION THEORY
Electromagnetic scattering from nonlinear anisotropic cylinders N88-23930

PETRI NETS
Simultaneous use of artificial intelligence and Petri nets: Application to the monitoring of a fabrication plan
[LAAS-87-354] N88-24207

PH
Complexation and hydrolysis reactions of iron(III) N88-23867

PHASE SHIFT
Doppler radar with multiphase modulation of transmitted and reflected signal
[NASA-CASE-MSC-18808-1] N88-23923

PHASE SHIFT CIRCUITS
Development of 20 GHz monolithic transmit modules
[NASA-CR-182134] N88-24539

PHENYLS
Boundary layer flow visualization for flight testing N88-23742

PHOBOS
Power requirements for mining and microwave processing of extraterrestrial resources N88-24389

PHOSPHATES
Recent advances in metallic/ceramic coatings for corrosion control in military applications N88-23858

PHOSPHONIUM COMPOUNDS
Corrosion and corrosion inhibition of metals/alloys in methyphosphonic difluoride N88-23850

PHOTOACOUSTIC MICROSCOPY
Nondestructive Evaluation (NDE) of structural ceramics by photoacoustic microscopy N88-23884

PHOTOCHEMICAL REACTIONS
Modification of polymers by photografting processes N88-23871
Chemical kinetics and photochemical data for use in stratospheric modeling evaluation Number 8
[NASA-CR-182919] N88-24012

PHOTODIODES
Application of chaos theory to 1/f noise
[AD-A191150] N88-23935

PHOTOGRAMMETRY
Stereoscopic photographs, ground and aerial, of trees used in the arborization of Curitiba (PR) N88-24091
Adjustment in photogrammetry: Methods, programs and applications
[B8735130] N88-24105

PHOTOGRAPHY
The USSR space systems for remote sensing of earth resources and the environment (sensor systems, processing techniques, applications) N88-24035

PHOTOINTERPRETATION
An integrated study of the Alto Paranaiba Kimberlite Province, Minas Gerais, Brazil: A possible tool for diamond exploration N88-24031
Anomalies in the vegetation in the Alto Xingu - MT N88-24043
Remote sensing and structural rupture: Application examples in the study of tectonics N88-24050
Analysis and interpretation of image lithostructure: An application of the multiconcept in the metamorphic belt of Sul de Santana da Boa Vista (RS) N88-24051
Application of its transformation in color enhancement of LANDSAT imagery N88-24082
The 35 mm vertical aerial photographs for mapping stands of bracatinga in different age classes N88-24087
Stereoscopic photographs, ground and aerial, of trees used in the arborization of Curitiba (PR) N88-24091
Characteristics of drainage determinations in aerial photographs and relief determination on different scales planialtimetric charts for three soils in the state of Sao Paulo N88-24095
Lithostructural interpretation of Chapda do Cachimbo (Pa-Am-Mt), based on radar and LANDSAT imagery N88-24100

PHOTOIONIZATION
Total photoionization cross sections of atomic oxygen from threshold to 44.3A
[NASA-CR-182992] N88-24252

PHOTOSENSITIVITY
Dynamic range compression/expansion of light beams by photorefractive crystals
[NASA-CASE-NPO-17140-1-CU] N88-24508

PHOTOVOLTAIC CELLS
Power source selection for neutral particle beam systems N88-24314

PHOTOVOLTAIC CONVERSION
Three-dimensional models of conventional and vertical junction laser-photovoltaic energy converters
[NASA-TM-4039] N88-24111

PIEZOELECTRICITY
Characterization of noncontact piezoelectric transducer with conically shaped piezoelement
[NASA-CR-4151] N88-23987

PILOT TRAINING
A look toward the future of complex avionics systems development using the USAF Test Pilot School's avionics systems test training aircraft N88-23797

PIONS
Subthreshold pion production in proton induced reactions at 180 to 201 MeV and He3 at 283 MeV
[ETN-88-92303] N88-24250

PIPE FLOW
Tests on oscillating flows in a pipe nozzle with an abrupt diameter variation
[MPIS-2/1987] N88-23947
Modeling of cavitation phenomena in homogeneous flow in transitory regimes in pipes
[ISAL-IDI1-87-15] N88-23948

PIPELINING (COMPUTERS)
Real time pipelined system for forming the sum of products in the processing of video data
[NASA-CASE-NPO-16462-1-CU] N88-24169

PIPES (TUBES)
A reflux tube fabric radiator N88-24394

PISTONS
Composite piston
[NASA-CASE-LAR-13435-1] N88-23981

PIXELS
Textural features for image classification in remote sensing N88-24027
Study of methods of post-processing applied to a problem of standard classification N88-24067

PLANE STRAIN
Fracture mechanics N88-23877

PLANE WAVES
Saturation and the limit of jet mixing enhancement by single frequency plane wave excitation: Experiment and theory
[NASA-TM-100882] N88-23732
Electromagnetic scattering from nonlinear anisotropic cylinders N88-23930

PLANETARY SURFACES
Electromagnetic powered vehicles (EMPV) for Mars exploration N88-24388

PLANETOLOGY
Reflectance spectroscopy in planetary science: Review and strategy for the future [NASA-SP-493] N88-24564
Research and Technology, 1987, Goddard Space Flight Center N88-24572
PLANNING
Identification of areas cultivated with soybeans in the cerrados regions, through digital processingof satellite images: A methodological approach N88-24048
PLANTS (BOTANY)
The 35 mm vertical aerial photographs for mapping stands of bracatinga in different age classes N88-24067
Mapping of plant associations and the variation of surface water in the Pantanal Mato-Grossense National Park, through remote sensing techniques N88-24092
Botany Facility: The problems of plant fixation [SIRA-A/7373/WP220/RJS/001] N88-24140
Botany Facility: Problems of water supply, plant nutrients and soil in the Botany Facility [SIRA-A/7373/WP220/RJS/003] N88-24141
Supply and distribution of plant nutrients in the Botany Facility [SIRA-A/7373/WP220/RJS/004] N88-24142
PLASMA CONTROL
A fusion based plasma propulsion system N88-24274
Fluid dynamics of spherical cavity reactors N88-24291
PLASMA CORE REACTORS
Fluid dynamics of spherical cavity reactors N88-24291
PLASMA DENSITY
Summary report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements --- plasma diagnostics [IPPJ-861] N88-24512
Tokamak studies of density sensitive line ratios N88-24521
Density diagnostics by hydrogen line intensity ratios: Excitation cross section between excited states N88-24522
Spectral diagnostics for temperature and density measurements on ATF N88-24525
Measurements of Z(sub eff) profile with a visible bremsstrahlung continuum detector array N88-24529
PLASMA DIAGNOSTICS
Summary report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements --- plasma diagnostics [IPPJ-861] N88-24512
Ion temperature measurement with spectroscopy in JT-60 N88-24513
X-ray emission from tokamaks N88-24514
X-ray spectroscopic diagnostics on JIPPT-IIU and HELIOTRON-E N88-24515
Helium-like titanium spectra from tokamak plasmas N88-24516
Spectroscopic results from JET: Some examples of data comparison and data needs N88-24517
Ion temperature profile measurement using charge exchange recombination spectroscopy on JIPP T-IIU N88-24518
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D N88-24519
Forbidden transitions as ion-temperature sensitive lines N88-24520
Tokamak studies of density sensitive line ratios N88-24521
Density diagnostics by hydrogen line intensity ratios: Excitation cross section between excited states N88-24522
Spectroscopic study of heliotron E plasmas: Stark profile, CXR, poloidal rotation and carbon coating N88-24523
Observation of injected silicon in heliotron E N88-24524
Spectral diagnostics for temperature and density measurements on ATF N88-24525
Cascade fluorescences from laser-excited lithium atom for plasma diagnostics N88-24526
Spectroscopic data relevant to alpha particle diagnostics N88-24527
Flux density measurements of neutral iron in TEXTOR with laser induced fluorescence N88-24528
Measurements of Z(sub eff) profile with a visible bremsstrahlung continuum detector array N88-24529
Hot electron diagnostics using X-ray imaging on GAMMA10 N88-24530
Polarization spectroscopy: Prospect and data needs N88-24531
Intensity calibration of a VUV system by branching line pairs N88-24533
Availability and quality of spectroscopic data and standards for tokamak studies N88-24534
PLASMA DYNAMICS
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D N88-24519
PLASMA ENGINES
Megawatt level electric propulsion perspectives N88-24294
PLASMA HEATING
Measurements of Z(sub eff) profile with a visible bremsstrahlung continuum detector array N88-24529
PLASMA PROPULSION
Interplanetary propulsion using inertial fusion N88-24273
A fusion based plasma propulsion system N88-24274
PLASMA RADIATION
X-ray emission from tokamaks N88-24514
Polarization spectroscopy: Prospect and data needs N88-24531
PLASMA SPECTRA
Ion temperature measurement with spectroscopy in JT-60 N88-24513
X-ray emission from tokamaks N88-24514
X-ray spectroscopic diagnostics on JIPPT-IIU and HELIOTRON-E N88-24515
Helium-like titanium spectra from tokamak plasmas N88-24516
Spectroscopic results from JET: Some examples of data comparison and data needs N88-24517
Ion temperature profile measurement using charge exchange recombination spectroscopy on JIPP T-IIU N88-24518
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D N88-24519
Forbidden transitions as ion-temperature sensitive lines N88-24520
Tokamak studies of density sensitive line ratios N88-24521
Density diagnostics by hydrogen line intensity ratios: Excitation cross section between excited states N88-24522
Observation of injected silicon in heliotron E N88-24524
Spectral diagnostics for temperature and density measurements on ATF N88-24525
Intensity calibration of a VUV system by branching line pairs N88-24533
Availability and quality of spectroscopic data and standards for tokamak studies N88-24534
PLASMA TEMPERATURE
Summary report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements --- plasma diagnostics [IPPJ-861] N88-24512
Spectroscopic study of heliotron E plasmas: Stark profile, CXR, poloidal rotation and carbon coating N88-24523
Spectral diagnostics for temperature and density measurements on ATF N88-24525
PLASMAS (PHYSICS)
On the magnetic structure and energy balance of EUV-emitting plasma in the quiet Sun N88-24567
PLASMONS
Enhancement of second harmonic generation on silver gratings by resonant excitation of surface plasmon [ETN-88-92304] N88-24509
PLATE THEORY
A generalized variational method for solving stress intensity factors at cracks on the edge of holes in orthotropic plates [IC-AERO-87-02] N88-23992
PLUGS
Rotor self-lubricating axial stop [NASA-CASE-MFS-28273-1] N88-23974
PLUMES
Detection of biomass burning and smoke plumes in the Amazon region through NOAA satellite imagery N88-24085
PLUTONIUM 238
BIFOLD: A dual-mode nuclear space power system N88-24292
POINT DEFECTS
Point defects in irradiated silicates N88-24319
POINTS (MATHEMATICS)
Automatic registration of satellite imagery N88-24080
POLAR REGIONS
Centrifugal acceleration of ions in the polar magnetosphere [NASA-TM-101148] N88-24120
Cloud cover determination in polar regions from satellite imagery [NASA-CR-182906] N88-24123
POLARIZATION (WAVES)
Polarization spectroscopy: Prospect and data needs N88-24531
POLICIES
A proposed national policy concerning the reentry of space reactors N88-24359
POLLEN
Examination of methods for pollen storage and dispersal [TN-RB524-097/86] N88-24134
POLOIDAL FLUX
An introduction to poloidal and toroidal fields [MITT-54] N88-24232
POLYIMIDES
Carboxylate formation at the interface between a polyimide coating and cobalt N88-23859
POLYMER CHEMISTRY
Structural Ceramics [NASA-CP-2427] N88-23872
POLYMERIC FILMS
Polymer fuel cell as an energy storage component for space power applications N88-24452
POLYMERIZATION
Complexation and hydrolysis reactions of iron(III) N88-23867
Polymer precursors for SiC ceramic materials N88-23889
Polymer precursors for ceramic composites N88-23890
POLYMERS
Modification of polymers by photografting processes N88-23871
POLYNOMIALS
On a classification of problems on sets of bilinear forms by formal polynomials [RR-642-I-IMAG-53-LIFIA] N88-24219
POROSITY
Krypton based adsorption type cryogenic refrigerator [NASA-CASE-NPO-17334-1-CU] N88-23917
PORTABLE EQUIPMENT
An investigation of conformable antennas for the astronaut backpack communication system [NASA-CR-182908] N88-23929
POSITION (LOCATION)
Point accessibility and primary workspace of simple six-link robots N88-23976
Angular position measurements at high temperatures and high radiation environments N88-24479
POSITION INDICATORS
Integrated multisensor navigation systems N88-23722
POSITIONING
A control technique for improved robot performance N88-24212
POTENTIAL THEORY
Full potential methods for analysis/design of complex aerospace configurations [NASA-CR-3982] N88-23736
On the efficient implementation of the fast multipole algorithm [AD-A191167] N88-24173
POWDER (PARTICLES)
Colloidal characterization of silicon nitride and silicon carbide N88-23883
POWDER METALLURGY
Fabrication of reactor shields at the Y-12 plant N88-24283
POWER AMPLIFIERS
Development of 20 GHz monolithic transmit modules [NASA-CR-182134] N88-24539
POWER CONDITIONING
Application of the reactivity constraint approach to the transient control of spacecraft reactors N88-24305
Reactor instrumentation and control design and performance simulation for SP-100 N88-24306
Nuclear reactor magnetohydrodynamic power generator for directed energy weapons N88-24336
Parametric analyses of the TE SP-100 system performance N88-24358
Energy storage evaluation for burst power applications N88-24430
Multimegawatt power conditioning requirements study N88-24504
POWER CONVERTERS
SNAP-DYN: Concepts for multikilowatt space power applications N88-24486
Alkali metal thermoelectric converter design for space power systems applications N88-24499
POWER EFFICIENCY
Low power consumption current transducer [NASA-CASE-NPO-16888-1-CU] N88-23937
POWER LINES
Asymptotics for a system of nonlinearly coupled wave equations with an application to the galloping oscillations of overhead transmission lines [REPT-87-78] N88-23991
POWER REACTORS
Low power consumption current transducer [NASA-CASE-NPO-16888-1-CU] N88-23937

POWER SUPPLY CIRCUITS
Arc lamp power supply using a voltage multiplier
[NASA-CASE-LAR-13202-1] N88-23942
PRECIPITATION
Digital processing of infrared and visible images from the GOES satellite and its integration with meteorological radar data N88-24057
PREDICTION ANALYSIS TECHNIQUES
PAN AIR analysis of the NASA/MCAIR 279-3: An advanced supersonic V/STOL fighter/attack aircraft
[NASA-TM-86638] N88-23750
The prediction of satellite lifetimes
[RAE-TR-87030] N88-23818
Ceramics for turbine engines N88-23873
Some design considerations for ceramic components in heat engine applications N88-23875
Generalized predictive control of multivariable systems
[OUEL-1640/86] N88-24209
A recursive prediction error parameter estimator for nonlinear models
[RR-328] N88-24222
PREDICTIONS
Development and testing of a predictive methodology for optimization of man-machine interface in future avionics systems N88-23780
PRESSURE DISTRIBUTION
Methodology for matching experimental and computational aerodynamic data
[NASA-TM-100592] N88-23728
Pressure distributions from subsonic tests of an advanced laminar-flow-control wing with leading- and trailing-edge flaps
[NASA-TM-4040-PT-1] N88-23758
PRESSURE DRAG
Multi-body aircraft with an all-movable center fuselage actively controlling fuselage pressure drag
[NASA-CASE-LAR-13511-1] N88-23765
PRESSURE GRADIENTS
Computational wing design studies relating to natural laminar flow N88-23740
Surface curvature and pressure gradient effects on turbulent flow: An assessment based on numerical solution of the Reynolds equations N88-23954
PRESSURE MEASUREMENT
Unsteady pressure and structural response measurements of an elastic supercritical wing
[NASA-TM-100591] N88-23756
Pressure measuring probe
[NASA-CASE-LAR-13853-1] N88-23961
PRESSURE SENSORS
Boundary layer measurements using hot-film sensors N88-23743
Pressure measuring probe
[NASA-CASE-LAR-13853-1] N88-23961
PRESSURE VESSELS
Cellular thermosetting fluoropolymers and process for making them
[NASA-CASE-GSC-13008-1] N88-23894
PRETREATMENT
Colloidal characterization of silicon nitride and silicon carbide N88-23883
PRIMERS (COATINGS)
Polyitaconic acid macromolecule primer for adhesive bonding and corrosion control of aluminum N88-23849
Water based primers for structural adhesive bonding of aircraft N88-23862
PROBABILITY DENSITY FUNCTIONS
Almost sure L(gamma)-norm convergence for data-based histogram density estimates
[AD-A189944] N88-24228
PROBABILITY THEORY
Restrictions in activity monitoring through remote sensing N88-24084
Induction of models under uncertainty
[NASA-TM-101173] N88-24230
PROBLEM SOLVING
Numerical modelling of flows using phoenics N88-23955
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24026
Navigation system from AVHRR data from NOAA series satellites N88-24054
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24068
PROCESS CONTROL (INDUSTRY)
Simultaneous use of artificial intelligence and Petri nets: Application to the monitoring of a fabrication plan
[LAAS-87-354] N88-24207
PROCUREMENT
Developing systems using state-of-the-art CAD/CAM technology N88-23795
PRODUCT DEVELOPMENT
Summary of the activities performed during the Botany Facility (BF) predevelopment phase for the Life Support S/S (LSS)
[TB-RB524-002/87] N88-24133
PRODUCTIVITY
Practical image analysis using personal computers: The Canadian experience N88-24037
Interpretation of MSS/LANDSAT data for evaluation of physical distribution of mangroves in Cananeia-Iguape (SP) N88-24072
Research on enhancing the utilization of digital multispectral data and geographic information systems in global habitability studies
[NASA-CR-182799] N88-24101
PROGRAM VERIFICATION (COMPUTERS)
Testing complex avionics software: A practical experience N88-23794
A benchmark for galactic cosmic ray transport codes
[NASA-TM-101157] N88-24571
PROGRAMMING LANGUAGES
Linguistic definition of generic models in computer vision
[RSRE-MEMO-4110] N88-24182
PROJECT MANAGEMENT
The integration, characterisation and trialling of a modern complex airborne radar N88-23791
Outline of the GPCP strategy N88-24007
PROJECTILES
Power and energy requirements for electromagnetic launchers N88-24391
PROJECTS
Defense Small Business Innovation Research Program (SBIR). Volume 3: Air Force abstracts of phase 1 awards, 1987 N88-24548
PROPAGATION VELOCITY
The determination of gravity and topography from seismic velocities, accounting for dynamic behavior of the Earth's mantle
[ETN-88-92420] N88-24117
PROPELLANT STORABILITY
Uranium nitride fuel swelling and thermal conductivity correlations N88-24327
PROPELLANT STORAGE
Turbomachinery in space N88-24321
PROPULSION SYSTEM CONFIGURATIONS
The challenges and opportunities of supersonic transport propulsion technology
[NASA-TM-100921] N88-23806
Heat transfer in aerospace propulsion
[NASA-TM-100874] N88-23957
Nuclear propulsion systems for orbit transfer based on the particle bed reactor N88-24272
PROPULSION SYSTEM PERFORMANCE
Nuclear propulsion systems for orbit transfer based on the particle bed reactor N88-24272
High power ion thruster performance N88-24295
Gas core reactors for direct nuclear propulsion N88-24442
Status of high power electric propulsion technology N88-24443
Noncryogenic propellants for a nuclear orbit transfer vehicle N88-24444
PROPULSIVE EFFICIENCY
Propulsive performance of a lifting flapping wing N88-23733
Benefits of 20 kHz PMAD in a nuclear space station N88-24256
High power ion thruster performance N88-24295
PROPYL COMPOUNDS
Identification of hydroxypropyl starch hydrolysate components N88-23832
PROTECTIVE COATINGS
Inadequacies of EMI-seal material: A corrosion study N88-23852
Surface conditioning products as tools for corrosion removal and corrosion prevention N88-23856
Carboxylate formation at the interface between a polyimide coating and cobalt N88-23859
PROTOCOL (COMPUTERS)
A five-layer Open Systems Interconnection (OSI) implementation N88-24204
PROTOTYPES
Rapid prototyping of complex avionic system architectures N88-23771
The integration, characterisation and trialling of a modern complex airborne radar N88-23791
Coherent functional development: Key to successful future system integration N88-23803
SP-100 GES test site N88-24375
PROVING
Knowledge based system verification and validation as related to automation of space station subsystems: Rationale for a knowledge based system lifecycle N88-24192
PSYCHOLOGICAL TESTS
NASA-Ames workload research program N88-24151
PSYCHOMOTOR PERFORMANCE
Teleoperator human factors study
[NASA-CR-178930] N88-24162
PUBLIC RELATIONS
Nuclear safety as applied to space power reactor systems N88-24360
PULSE COMMUNICATION
Design for interoperability (interchangeability) N88-23789
PULSE DURATION
Monolithic fuel cell based power source for sprint power generation N88-24313
Fundamental analysis of space nuclear-MHD generator for gigawatt-level power N88-24337
Burst power gas core reactor with MHD power generation N88-24472
PULSED RADIATION
Fundamental analysis of space nuclear-MHD generator for gigawatt-level power N88-24337
PULSES
Rotating-hoop, pulsed-energy converter N88-24433
PUMPS
Pumped two-phase heat transfer loop
[NASA-CASE-MSC-20841-2] N88-23958
PYROLYTIC MATERIALS
Disclination structures in carbon and graphite
[AD-A191056] N88-23868
PYROTECHNICS
Ariane 4 pyrotechnics system: Definition of the chains and pyrotechnic devices
[CNES-88/CT/DRT/TVE/IL/25] N88-23816

Q

QUADRUPOLES
The exact calculation of quadrupole sources for some incompressible flows
[NASA-TM-100623] N88-24240
QUALIFICATIONS
SP-100 flight qualification testing assessment N88-24414
QUALITY CONTROL
Systems engineering technique N88-23776
QUARKS
Quark core stars, quark stars and strange stars
[DE88-006991] N88-24555
QUATERNARY ALLOYS
Development of microencapsulated DNBM quaternary ammonium inhibitors for paints N88-23851
QUERY LANGUAGES
The SAGE geographic analysis system N88-24063
QUEUEING THEORY
Parallel discrete-event simulation of FCFS stochastic queueing networks
[NASA-CR-181669] N88-24203

R

RADAR
The integration, characterisation and trialling of a modern complex airborne radar N88-23791
RADAR DATA
Preparation and execution of calibration measurements for handling of airborne SAR data (AGRISAR)
[ETN-88-92338] N88-23926
RADAR IMAGERY
Preparation and execution of calibration measurements for handling of airborne SAR data (AGRISAR)
[ETN-88-92338] N88-23926
The Shuttle Imaging Radar B (SIR-B) experiment report
[NASA-CR-182923] N88-23932
Radar penetration in the Amazonian rain forest N88-24015
Airborne and spaceborne radar images for geologic and environmental mapping in the Amazon rain forest, Brazil N88-24021
Subsurface morphology and geoarchaeology revealed by spaceborne and airborne radar N88-24022
The use of SLAR and SIRA imagenes for the classification of forest typen in tropical rain forests N88-24036
Radar penetration in the Amazonian rain forest N88-24044
Analysis and interpretation of image lithostructure: An application of the multiconcept in the metamorphic belt of Sul de Santana da Boa Vista (RS) N88-24051
Digital processing of infrared and visible images from the GOES satellite and its integration with meteorological radar data N88-24057

Interpretation of MSS/LANDSAT data for evaluation of physical distribution of mangroves in Cananeia-Iguape (SP) N88-24072
Some geological aspects of the Pirapemas Lineament Belt N88-24099
Lithostructural interpretation of Chapda do Cachimbo (Pa-Am-Mt), based on radar and LANDSAT imagery N88-24100

RADAR MAPS
Digital monoplotting, part 1 [B8735122-PT-1] N88-24106
Digital monoplotting, part 2 [B8735122-PT-2] N88-24107

RADAR TRACKING
Space based radar application to air traffic control N88-24262

RADIANCE
The NBS scale of radiance temperature N88-23897
Estimation of total Outgoing Longwave Radiation (OLR) flux from geostationary meteorological satellite infrared window radiance N88-24006
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24066
Sky radiance distributions for thermal imaging backgrounds [AD-A191135] N88-24115

RADIATION DAMAGE
Space nuclear reactor shielding optimization studies N88-24320

RADIATION DETECTORS
Superconducting thin film vertex detector for SSC (Superconducting Super Collider) applications [DE88-005951] N88-24535

RADIATION DISTRIBUTION
Sky radiance distributions for thermal imaging backgrounds [AD-A191135] N88-24115

RADIATION DOSAGE
Modeling of radiation dose dependence of MOSFETs N88-24370
Analysis of a nuclear orbital transfer vehicle reentry accident N88-24426

RADIATION EFFECTS
The response of a power MOSFET (N-channel) and a dielectric isolated operational amplifier to the combined environmental effects of high temperature and total dose gamma radiation N88-24309
Radiation hardening design of nuclear powered spacecraft N88-24315
Defects in cubic silicon carbide on silicon N88-24317
Analysis of thermal and radiation effects in materials using the GEMAT process N88-24318
Radiation effects testing capabilities of the Texas A and M Nuclear Science Center N88-24368
Silicon-on-insulator electronics for a space nuclear power system N88-24461
The response of selected semiconductor technologies to the combined environmental effects of high temperature and total dose gamma radiation N88-24462
Neutron effects on the electrical and switching characteristics of NPN bipolar power transistors N88-24463
Development of refractory thermocouples for space nuclear power tests N88-24478

RADIATION HARDENING
Radiation effects testing capabilities of the Texas A and M Nuclear Science Center N88-24368

RADIATION HAZARDS
Operational concerns involving a shadow-shielded nuclear reactor for space station applications N88-24257
Radiation hardening design of nuclear powered spacecraft N88-24315
Nuclear safety as applied to space power reactor systems N88-24360

RADIATION MEASUREMENT
Sky radiance distributions for thermal imaging backgrounds [AD-A191135] N88-24115

RADIATION PROTECTION
Nuclear safety as applied to space power reactor systems N88-24360

RADIATION PYROMETERS
Noncontact Temperature Measurement [NASA-CP-2503] N88-23895
Radiation thermometry: The measurement problem N88-23896
Noncontact temperature measurement in glass and other transparent materials N88-23900
Multi-color pyrometer for materials processing in space N88-23905
Direct emissivity measurements on liquids and corrections to multi-color pyrometers N88-23906
Common but unappreciated sources of error in one, two, and multiple-color pyrometry N88-23907
Fast optical pyrometry N88-23908
The role of fiberoptics in remote temperature measurement N88-23909
Laser pyrometry N88-23910
Noncontact true temperature measurement, 2 N88-23911

RADIATION SHIELDING
Operational concerns involving a shadow-shielded nuclear reactor for space station applications N88-24257
Material tradeoffs to minimize flooding reactivity N88-24265
Magnet shielding analysis for SOAR: A space fusion reactor N88-24269
Fabrication of lithium hydride shields for space nuclear power systems N88-24282
Fabrication of reactor shields at the Y-12 plant N88-24283
Radiation hardening design of nuclear powered spacecraft N88-24315
Space nuclear reactor shielding optimization studies N88-24320
Comparison of open and closed multimegawatt space power systems N88-24353
RSMASS: A simple model for estimating reactor/shield masses N88-24355
MMW shielding design and analysis N88-24457
Neutron effects on the electrical and switching characteristics of NPN bipolar power transistors N88-24463

RADIATION SOURCES
SNAP-DYN: Proven technology for wear-term, higher power in space N88-24422

RADIATION TOLERANCE
Neutron radiation tolerance of Au-activated silicon N88-24316

RADIATIVE HEAT TRANSFER
Liquid-metal MHD power conversion for space electric systems N88-24338
Transient thermohydraulic heat pipe modeling N88-24347
Development of materials for fabric radiators N88-24448

RADII
Fitting a circle to radially suppressed data [NPL-DITC-103/87] N88-24223

RADIO ANTENNAS
Environmental projects. Volume 6: Environmental assessment. New 34-meter antenna at Venus site [NASA-CR-182922] N88-23919

RADIO COMMUNICATION
An investigation of conformable antennas for the astronaut backpack communication system [NASA-CR-182908] N88-23929

RADIO TRANSMISSION
Environmental projects. Volume 6: Environmental assessment. New 34-meter antenna at Venus site [NASA-CR-182922] N88-23919

RADIO WAVES
Power source selection for neutral particle beam systems N88-24314

RADIOACTIVE DECAY
A proposed national policy concerning the reentry of space reactors N88-24359

RADIOACTIVE ISOTOPES
The Light-Weight Radioisotope Heater Unit (LWRHU): Development and application N88-24299
MHW RTG performance during LES 8/9 and Voyager missions N88-24300
Pioneer 10 and 11 RTG performance update N88-24301

RADIOACTIVE MATERIALS
The dynamic isotope power system: Technology status and demonstration program N88-24400

RADIOACTIVE WASTES
Comparison of open and closed multimegawatt space power systems N88-24353
Space reactor end of life issues N88-24413

RADIOGRAPHY
Method of radiographic inspection of wooden members [NASA-CASE-LAR-13724-1] N88-23983

RADIOISOTOPE BATTERIES
Transactions of the Fourth Symposium on Space Nuclear Power Systems [DE88-006164] N88-24254
The Light-Weight Radioisotope Heater Unit (LWRHU): Development and application N88-24299
Foil gas bearing system endurance testing dynamic isotope power system N88-24302
Two-phase fluid management for a Rankine cycle isotope power system N88-24303
Innovative methodology and developments in US space radioisotope power safety risk assessments N88-24362
Status of modular RTG technology N88-24403

RADIOMETERS
Navigation system from AVHRR data from NOAA series satellites N88-24054

RADIOSONDES
Tiros operational vertical sounder (TOVS) and radiosonding in the region N88-24059

RAIN
Airborne and spaceborne radar images for geologic and environmental mapping in the Amazon rain forest, Brazil N88-24021

RAINDROPS
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125

RAMAN SPECTRA
Theoretical studies of Resonance Enhanced Stimulated Raman Scattering (RESRS) of frequency doubled Alexandrite laser wavelength in cesium vapor [NASA-CR-182871] N88-23841

RAMAN SPECTROSCOPY
Requirements for temperature and species concentration measurements in microgravity combustion experiments N88-23903
Laser Diagnostics for combustion temperature and species measurements N88-23912
Micro-Raman analysis of dielectric optical thin films [AD-A191228] N88-24537

RAMJET ENGINES
Aeropropulsive characteristics of isolated combined turbojet/ramjet nozzles at Mach numbers from 0 to 1.20 [NASA-TP-2814] N88-23757

RANDOM VARIABLES
Mahler's method in transcendence theory N88-24227

RANKINE CYCLE
Two-phase fluid management for a Rankine cycle isotope power system N88-24303
An experiment to investigate Rankine cycle two-phase microgravity issues N88-24322
Design of a high-power-density Ljungstroem turbine using potassium as a working fluid N88-24323
Nuclear Rankine/flywheel MMW space power concept N88-24349
Status of the organic Rankine cycle for space applications N88-24402
Optimization of organic Rankine cycles for space station applications N88-24407
Dynamic isotope power system critical component verification N88-24421
SNAP-DYN: Proven technology for wear-term, higher power in space N88-24422
Energy storage for nuclear burst power systems N88-24431
Review of alkali metal and refractory alloy compatibility for Rankine cycle applications N88-24447
Trade study for kWe class space reactors N88-24454
A high power density radial-in-flow reactor split core design for space power systems N88-24455
Experimental demonstrations of organic Rankine cycle waste heat rejection systems N88-24469
Potassium Rankine power system for space power N88-24476
A combined Rankine/Brayton pulse power cycle N88-24490
Energy conversion system optimization study for multimegawatt space nuclear power application N88-24492

RAYLEIGH SCATTERING
Laser Diagnostics for combustion temperature and species measurements N88-23912

REACTION BONDING
Carboxylate formation at the interface between a polyimide coating and cobalt N88-23859

REACTION KINETICS
Chemical kinetics and photochemical data for use in stratospheric modeling evaluation Number 8 [NASA-CR-182919] N88-24012
Experiments on reactions of the electronically excited molecule nitron NH (a sup 1 delta) and carbon CH2 (a bar sup 1 A(1)) in gas phase [MPIS-3/1987] N88-24249

REACTIVITY
Agenda for advancing electrochemical science and technology N88-23861
Effects of space-dependent cross sections on core physics parameters for compact fast spectrum space power reactors N88-24263
Application of the reactivity constraint approach to the transient control of spacecraft reactors N88-24305
A review of diffusion barrier technology for application in SP-100 fuel pins N88-24328

REACTOR CORES
Transactions of the Fourth Symposium on Space Nuclear Power Systems [DE88-006164] N88-24254

Effects of space-dependent cross sections on core physics parameters for compact fast spectrum space power reactors N88-24263
Considerations pertinent to the Doppler effect for space reactors N88-24264
Material tradeoffs to minimize flooding reactivity N88-24265
Thermal-hydraulic considerations for particle bed reactors N88-24266
Fully passive space reactor conceptual design N88-24288
Acoustical gas core reactor with MHD power generation for burst power in a bimodal system N88-24290
Interaction of the control system with core nuclear design for fast spectrum space power reactors N88-24304
Advanced thermionic converter technology for inductive output coupling N88-24311
Cermet fuel thermal conductivity N88-24329
Transient analysis of heat pipe vapor dynamics N88-24341
Fabrication of a niobium 1 percent zirconium containment for SP-100 primary lithium system materials mass transfer studies N88-24373
Reactor core coolability with reduced power levels N88-24425
Benchmark physics experiments for SP-100 N88-24453
A high power density radial-in-flow reactor split core design for space power systems N88-24455

REACTOR DESIGN
Transactions of the Fourth Symposium on Space Nuclear Power Systems [DE88-006164] N88-24254
Status of CEA design and simulation studies of a 200 KWe turboelectric space power system N88-24268
Safety constraints and considerations in the development of nuclear powered propulsion N88-24276
Fully passive space reactor conceptual design N88-24288
Space based nuclear-pumped laser/reactor concepts N88-24289
The role of integral experiments and nuclear cross section evaluations in space nuclear reactor design N88-24293
Sodium heat engine/AMTEC system experiments N88-24325
Gas-cooled reactor power systems for space N88-24350
Development and implementation of a space nuclear safety program N88-24361
Innovative methodology and developments in US space radioisotope power safety risk assessments N88-24362
Advanced LMMHD space power generation concept N88-24364
Expert systems approach to modeling systems with the ATHENA thermal-hydraulics code N88-24365
SOAR: Space orbiting advanced fusion power reactor N88-24366
Multimegawatt nuclear power system for lunar base applications N88-24367
Neutronics conceptual design of a UF6-fueled gasesous laser system N88-24405
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428
Research and development of electrical insulators for thermionic applications N88-24449
MMW shielding design and analysis N88-24457
Ceramic electrical insulator development for thermoelectric SACE power system N88-24459
Comparison of 20-kWe space nuclear power systems: Impact of reactor temperature and technology upon system design and performances N88-24475
Small particle bed reactors: Sensitivity to Brayton cycle parameters N88-24487
SP-100 ground engineering systems test facility control systems N88-24496
TRICE design, evaluation and feasibility tests N88-24498
Lightweight power bus for a baseload nuclear reactor in space N88-24505

REACTOR MATERIALS
Material tradeoffs to minimize flooding reactivity N88-24265
Thermal-hydraulic considerations for particle bed reactors N88-24266
Particle bed reactor scaling relationships N88-24267
Fabrication of reactor shields at the Y-12 plant N88-24283
Ammonia cleanup of lithium containing components N88-24287
The role of integral experiments and nuclear cross section evaluations in space nuclear reactor design N88-24293
Innovative methodology and developments in US space radioisotope power safety risk assessments N88-24362
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites N88-24427
Liquid metal testing at ETEC for the SP-100 program N88-24446

REACTOR PHYSICS
Effects of space-dependent cross sections on core physics parameters for compact fast spectrum space power reactors N88-24263
Fast critical experiment data for space reactors N88-24286
The role of integral experiments and nuclear cross section evaluations in space nuclear reactor design N88-24293
ATHENA heat pipe transient model N88-24344
Neutronics conceptual design of a UF6-fueled gasesous laser system N88-24405
Benchmark physics experiments for SP-100 N88-24453

REACTOR SAFETY
Transactions of the Fourth Symposium on Space Nuclear Power Systems [DE88-006164] N88-24254
Operational concerns involving a shadow-shielded nuclear reactor for space station applications N88-24257
Considerations pertinent to the Doppler effect for space reactors N88-24264
Material tradeoffs to minimize flooding reactivity N88-24265
Safety constraints and considerations in the development of nuclear powered propulsion N88-24276
Fast critical experiment data for space reactors N88-24286
The role of integral experiments and nuclear cross section evaluations in space nuclear reactor design N88-24293
Reactor instrumentation and control design and performance simulation for SP-100 N88-24306
Development and implementation of a space nuclear safety program N88-24361
Innovative methodology and developments in US space radioisotope power safety risk assessments N88-24362
Inherently safe space reactors N88-24363
A novel plant protection strategy for transient reactors N88-24423
Evaluation of UN fuel pin failure modes and motion of fuel during severe accidents for reactors in space N88-24424
Reactor core coolability with reduced power levels N88-24425
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428
The NERVA derivative reactor and a systematic approach to multiple space power requirements N88-24458
Automatic reactor control system for transient operation N88-24493
An optimal disturbance rejection control system for multimegawatt space nuclear power systems N88-24495
SP-100 ground engineering systems test facility control systems N88-24496

REACTOR TECHNOLOGY
Transactions of the Fourth Symposium on Space Nuclear Power Systems [DE88-006164] N88-24254
Status of CEA design and simulation studies of a 200 KWe turboelectric space power system N88-24268
Comparison of 20-kWe space nuclear power systems: Impact of reactor temperature and technology upon system design and performances N88-24475
Potassium Rankine power system for space power N88-24476
Small particle bed reactors: Sensitivity to Brayton cycle parameters N88-24487

REAL TIME OPERATION
Real time thermal imaging of high temperature semiconductor melts N88-23914
A timing evaluator for C programs generated by the model system [AD-A191204] N88-24174
Genetic algorithms for adaptive real-time control in space systems N88-24195
TES: A modular systems approach to expert system development for real-time space applications N88-24197

RECONNAISSANCE AIRCRAFT
The specification and design of a future maritime reconnaissance aircraft N88-23772

RECURSIVE FUNCTIONS
A recursive prediction error parameter estimator for nonlinear models [RR-326] N88-24222

REDUCED GRAVITY
Noncontact temperature measurements in the microgravity fluids and transport phenomena discipline N88-23901
Microgravity combustion discipline working group summary of requirements for noncontact temperature measurements N88-23902
Requirements for temperature and species concentration measurements in microgravity combustion experiments N88-23903
Separation of biological materials in microgravity [NASA-TM-101142] N88-23916
An experiment to investigate Rankine cycle two-phase microgravity issues N88-24322
Theoretical and experimental investigation of swirl flow phase separators for microgravity applications N88-24335
Microgravity thaw experiment (MITEX) N88-24439
Reduced-gravity two-phase flow experiments in the NASA KC-135 N88-24465
Analysis and interpretation of low gravity boiling experiments in the KC-135 N88-24466
Microgravity two-phase fluid flow pattern modeling N88-24467
Experimental investigation of a microgravity separator for two phase mixtures containing small volumes of gas/vapor N88-24468
Low gravity thermal management using dielectrophoretic forces N88-24470

REENTRY
Analysis of a nuclear orbital transfer vehicle reentry accident N88-24426

REFLECTANCE
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24020
The use of SLAR and SIRA imagenes for the classification of forest typen in tropical rain forests N88-24036
Analysis of the parameters responsible for the variations of the illumination conditions in the LANSAT data N88-24070

REFLECTORS
LDR structural experiment definition [NASA-TM-100618] N88-23826

REFRACTION
Refraction in underwater acoustics --- navigation systems [B8735053] N88-24236

REFRACTIVITY
Dynamic range compression/expansion of light beams by photorefractive crystals [NASA-CASE-NPO-17140-1-CU] N88-24508

REFRACTORY METAL ALLOYS
Review of alkali metal and refractory alloy compatibility for Rankine cycle applications N88-24447

REFRACTORY METALS
Development of reliable fuel pins for space reactor applications N88-24326

REFRIGERATORS
Krypton based adsorption type cryogenic refrigerator [NASA-CASE-NPO-17334-1-CU] N88-23917
Cryogenic regenerator including saran-carbon heat conduction matrix [NASA-CASE-NPO-17291-1-CU] N88-23946

REFUELING
Fault diagnosis in orbital refueling operations N88-24154

REGENERATION (ENGINEERING)
Cryogenic regenerator including saran-carbon heat conduction matrix [NASA-CASE-NPO-17291-1-CU] N88-23946

REGENERATION (PHYSIOLOGY)
Evaluation of a burned area and the vegetation regeneration affected by the burning in the Parque Nacional de Brazilia through TM/LANDSAT data N88-24073

REGENERATIVE COOLING
Review of convectively cooled structures for hypersonic flight [NASA-TM-87740] N88-23817

REGENERATIVE FUEL CELLS
Candidate advanced energy storage concepts for multimegawatt burst power systems N88-24434
Monolithic fuel cell based power source for burst power generation N88-24450
High power density alkaline fuel cell technology for MMW space burst power N88-24451

REGENERATORS
Assessment of energy storage concepts for use in sprint power N88-24312
Fatigue failure of regenerator screens in a high frequency Stirling engine N88-24491

REGIMES
On regime selection in global atmospheric flow
N88-24119
REGIONAL PLANNING
Analyses of heliport system plans
[DOT/FAA/PM-87/31] N88-23810
REGOLITH
Energy requirements for HE-3 mining operations on the Moon N88-24390
REGRESSION ANALYSIS
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24020
Estimation of an area cultivated with wheat from LANDSAT data through a two-phase sampling method
N88-24041
Evaluation of an estimation system for an irrigated area in a tropical region through TM-LANDSAT imagery
N88-24075
On Hotelling's approach to testing for a nonlinear parameter in regression
[AD-A191189] N88-24229
REGULATIONS
Advisory circular: Noise certification handbook
[FAA-AC-36-4B] N88-24234
Discussions and agreements in the United Nations on important issues associated with nuclear power in space
N88-24411
REINFORCING FIBERS
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites
N88-24427
RELIABILITY
Relating design and environmental variables to reliability N88-24383
Preliminary analysis of helium generation and its effects on the SP-100 system performance N88-24406
Johnson noise thermometer for high-radiation and high-temperature environments N88-24480
RELIABILITY ANALYSIS
Automatically generated acceptance test: A software reliability experiment
[NASA-CR-181667] N88-23984
RELIABILITY ENGINEERING
Integrated avionics reliability N88-23723
Advanced LMMHD space power generation concept
N88-24364
REMOTE CONTROL
Teleoperator human factors study
[NASA-CR-178930] N88-24162
A control technique for improved robot performance
N88-24212
REMOTE HANDLING
Space spider crane
[NASA-CASE-LAR-13411-1-SB] N88-23828
REMOTE SENSING
Thermal remote anemometer system
[NASA-CASE-LAR-13508-1] N88-23962
Prospects of satellite wind sensing systems in the years 1995-2000 N88-24004
The geometric workstation, a new approach for geometric corrections of remotely sensed data
N88-24017
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems
N88-24026
Shape detection in remote sensing through graph isomorphism N88-24028
Satellite remote sensing of turbidity and sediment concentration in Lagoa dos Patos N88-24032
Practical image analysis using personal computers: The Canadian experience N88-24037
International cooperation in remote sensing: The ESA experience N88-24038
ERS-1 data products and services and their value for tropical countries N88-24040
Estimation of an area cultivated with wheat from LANDSAT data through a two-phase sampling method
N88-24041
Remote sensing techniques in the estimation of the area cultivated with beans, corn, and castor beans in the Irece County (Bahia State) N88-24045
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems
N88-24066
Terrain classification using SPOT images and the computer system GOP-300
[FOA-C-20677-2.7] N88-24102
Soviet remote sensing research and technology
[FASAC-TAR-3130] N88-24106
An update on remote measurement of soil moisture over vegetation using infrared temperature measurements: A FIFE perspective
[NASA-CR-182926] N88-24109
Review of power requirements for satellite remote sensing systems N88-24387
The gamma 1 and gamma 3 bands of (16)O3: Line positions and intensities
[NASA-TM-101162] N88-24541
Reflectance spectroscopy in planetary science: Review and strategy for the future
[NASA-SP-493] N88-24564
REPEATERS
Spectral modelling of the soft gamma ray repeater
[DE88-007027] N88-24570
REQUIREMENTS
A structured approach to weapon system design
N88-23773
Advanced EVA system design requirements study
N88-24147
Advisory circular: Noise certification handbook
[FAA-AC-36-4B] N88-24234
Potassium Rankine power system for space power
N88-24476
Automatic reactor control system for transient operation N88-24493
RESCUE OPERATIONS
Design and development of an avionics system adapted to helicopter missions N88-23786
RESEARCH AIRCRAFT
Development of an airborne facility for advanced avionics research N88-23801
RESEARCH AND DEVELOPMENT
Preparing for the new programs. The ESA technological research and development program 1988-1990
[ESA-SP-1095] N88-23814
Structural ceramics research N88-23878
Soviet remote sensing research and technology
[FASAC-TAR-3130] N88-24106
Research and Technology, 1987, Goddard Space Flight Center N88-24572
RESEARCH FACILITIES
Development of an airborne facility for advanced avionics research N88-23801
Structures and Dynamics Division research and technology plans for FY 1988 and accomplishments for FY 1987
[NASA-TM-100585] N88-24000
Aerospace energy systems laboratory: Requirements and design approach
[NASA-TM-100423] N88-24206
RESEARCH MANAGEMENT
Fiber waveguide sensors for intelligent materials
[NASA-CR-183028] N88-23968
Structures and Dynamics Division research and technology plans for FY 1988 and accomplishments for FY 1987
[NASA-TM-100585] N88-24000
RESERVOIRS
Study of reservoir water quality utilizing remote sensing techniques: Methodological concepts N88-24076
Utilization of LANDSAT-TM imagery in the hydroenergetic inventory of the Paraiba de Sul River Basin N88-24077
RESIN MATRIX COMPOSITES
Influence of fiber reinforcement on the vitreous transition temperature of M 10 matrix composites
[ONERA-RT-44/7086-M] N88-23835
RESISTOJET ENGINES
Electric propulsion options for the SP-100 reference mission N88-24296
RESOLUTION
Television monitor field shifter and an opto-electronic method for obtaining a stereo image of optimal depth resolution and reduced depth distrotion on a single screen
[NASA-CASE-NPO-17249-1-CU] N88-23924
RESONANCE
Theoretical studies of Resonance Enhanced Stimulated Raman Scattering (RESRS) of frequency doubled Alexandrite laser wavelength in cesium vapor
[NASA-CR-182871] N88-23541
RESONANT FREQUENCIES
Single mode levitation and translation
[NASA-CASE-NPO-16675-1-CU] N88-24241
RESOURCES MANAGEMENT
A proposal for a project entitled assessment of forest resources in Uruguay submitted to the United Nations Industrial Development Organization (UNIDO)
N88-24016
Remote sensing and data integration: Practical solutions for resource managers N88-24034
Identification of areas cultivated with soybeans in the cerrados regions, through digital processingof satellite images: A methodological approach N88-24048
Research on enhancing the utilization of digital multispectral data and geographic information systems in global habitability studies
[NASA-CR-182799] N88-24101
RESPIRATION
Mathematical modelling of the heat and water vapour transport in the human respiratory tract N88-24160
RESPIRATORY SYSTEM
Mathematical modelling of the heat and water vapour transport in the human respiratory tract N88-24160
RHENIUM
Johnson noise thermometer for high-radiation and high-temperature environments N88-24480
RING LASERS
Monolithic integration on a GaAs substrate of a quarter ring laser and an optical guide coupled by an evanescent wave
[ETN-88-92308] N88-23969
RIVERS
Landuse and landform studies of the Mahanadi River Delta with the help of satellite MSS band N88-24033
Geomorphologic sector maps of Niquizanga-Mayares, province of San Juan, Argentina N88-24098
Influence of the Yukon River on the Bering Sea
[NASA-CR-182802] N88-24126
ROBOTICS
A design analysis for an automated robotic workpiece manipulator N88-23975
A software design tool for the analysis of robot dynamics properties
[NLR-MP-86064-4] N88-24171
A robotic language for cooperative multi-robots
N88-24186
A control technique for improved robot performance
N88-24212
Precise computer controlled positioning of robot end effectors using force sensors
[NASA-CR-182887] N88-24213
Energy optimal trajectory planning for robot manipulators and autonomous vehicles N88-24497
ROBOTS
Point accessibility and primary workspace of simple six-link robots N88-23976
A control technique for improved robot performance
N88-24212
Induction of models under uncertainty
[NASA-TM-101173] N88-24230
Energy optimal trajectory planning for robot manipulators and autonomous vehicles N88-24497
ROCKET ENGINE DESIGN
Arcjet thruster research and technology, phase 1
[NASA-CR-182107] N88-23830
ROCKET ENGINES
Test plan and facilities for qualifying nuclear rocket fuel elements N88-24482
ROCKET NOZZLES
Aeropropulsive characteristics of isolated combined turbojet/ramjet nozzles at Mach numbers from 0 to 1.20
[NASA-TP-2814] N88-23757
Arcjet thruster research and technology, phase 1
[NASA-CR-182107] N88-23830
ROCKET TEST FACILITIES
Test plan and facilities for qualifying nuclear rocket fuel elements N88-24482
ROLLERS
Brief evaluation of the alloy 17-4-PH (Z5 CNU 17-04). Semifinished product: 205 mm dia forged roller, test reports
[DF/NH-3616/84] N88-23866
ROTATING FLUIDS
Experimental demonstrations of organic Rankine cycle waste heat rejection systems N88-24469
ROTATION
Studies of heat and mass transfer during chemical vapor deposition N88-23953
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Part 4: Aerodynamic data tabulation
[NASA-CR-179469] N88-23956
A generic multibody simulation
[NASA-CR-182949] N88-24198
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D
N88-24519
ROTORS
Vibration and control of flexible rotor supported by magnetic bearings
[NASA-TM-100688] N88-23977
ROVER PROJECT
History of some direct nuclear propulsion developments since 1946 N88-24270
A critique of NERVA based nuclear reactor design and performance for MMW space propulsion applications
N88-24297
Nuclear propulsion: Past, present and future
N88-24441
The NERVA derivative reactor and a systematic approach to multiple space power requirements
N88-24458
ROVING VEHICLES
Electromagnetic powered vehicles (EMPV) for Mars exploration N88-24388

S

S WAVES
Input-output characterization of fiber composites by SH waves
[NASA-CR-4153] N88-23986
SAFETY
United Nations deliberations of the use of nuclear power sources in space: 1978-1987 N88-24410
Discussions and agreements in the United Nations on important issues associated with nuclear power in space N88-24411
Critical nuclear launch issues: A perspective from the State of Florida N88-24412
Space reactor end of life issues N88-24413
SAFETY DEVICES
Variable response load limiting device
[NASA-CASE-LAR-12801-1] N88-23982
SAFETY MANAGEMENT
Nuclear safety as applied to space power reactor systems N88-24360
SALINITY
Influence of the Yukon River on the Bering Sea
[NASA-CR-182802] N88-24126
SALYUT SPACE STATION
The USSR space systems for remote sensing of earth resources and the environment (sensor systems, processing techniques, applications) N88-24035
SAMPLING
Evaluation of an estimation system for an irrigated area in a tropical region through TM-LANDSAT imagery N88-24075
SATELLITE COMMUNICATION
Error control techniques for satellite and space communications
[NASA-CR-182886] N88-23922
SATELLITE DESIGN
Structural acoustics design manual
[ESA-PSS-03-1201-ISSUE-1] N88-23821
MSAT-X: A technical introduction and status report
[NASA-CR-182921] N88-23933
The high-throughput X-ray spectroscopy mission E6889478 MN513835 — ESA program
[ESA-SP-1092] N88-24554
SATELLITE DOPPLER POSITIONING
Solid Earth mission end-to-end data system study
[C04825.08/FR] N88-23811
SATELLITE IMAGERY
A low cost automatic Earth observation satellite tracking ground receiving station N88-23815
Meteorological Satellite Center Technical Note No. 16
[ISSN-0388-9653] N88-24003
Latitudinal and seasonal variation of the cloud characteristic parameters and their effects on the cloud classification N88-24005
Some problems with regard to the TOVS processing detected by using NOAA-HRPT data check program N88-24009
Enhanced infra-red picture of LR-FAX for spring and autumn seasons N88-24011
Latin American Symposium on Remote Sensing, 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, volume 1 N88-24013
A comparison of supervised maximum likelihood and decision tree classification for crop cover estimation from multitemporal LANDSAT MSS data N88-24014
Mapping from LANDSAT and SPOT satellite imagery N88-24018
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24020
Mapping soil and rock variation from satellite images in the Sahel N88-24023
An integrated study of the Alto Paranaiba Kimberlite Province, Minas Gerais, Brazil: A possible tool for diamond exploration N88-24031
Satellite remote sensing of turbidity and sediment concentration in Lagoa dos Patos N88-24032
Practical image analysis using personal computers: The Canadian experience N88-24037
Presentation of the METEOSAT system and the roles of EUMETSAT within the meteorological community N88-24039
ERS-1 data products and services and their value for tropical countries N88-24040
Estimation of an area cultivated with wheat from LANDSAT data through a two-phase sampling method N88-24041
Utilization of TM/LANDSAT images in the implanted forests mapping in the Mogi-Guacu Region (SP-Brazil) N88-24042
Anomalies in the vegetation in the Alto Xingu - MT N88-24043
Remote sensing techniques in the estimation of the area cultivated with beans, corn, and castor beans in the Irece County (Bahia State) N88-24045
CANASATE: Sugar cane mapping by satellite N88-24046
Spectral behavior of crops through analysis of LANDSAT-TM data N88-24047
Identification of areas cultivated with soybeans in the cerrados regions, through digital processingof satellite images: A methodological approach N88-24048
Structure and dynamics of vegetation in the middle semi-arid tropics, Quixaba's Caatinga (PE): Terrain analysis of MSS/LANDSAT data N88-24049
Study of fracturing for groundwater research in the Sergipe state with remote sensing products N88-24052
A system for determination of wind fields using geostationary meterological satellites N88-24056
Digital processing of infrared and visible images from the GOES satellite and its integration with meteorological radar data N88-24057
Thematic mapping utilizing data from the Thematic Mapper sensor of the LANDSAT satellite N88-24060
Geometric image correction: An approach for the registration of LANDSAT-TM digital images supported by topographical maps of medium and great scales N88-24061
Generation of thematic maps for updating aeronautical pilot charts utilizing LANDSAT-TM images N88-24062
Evolution of a family of image processing systems at INPE N88-24065
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24066
Analysis of the parameters responsible for the variations of the illumination conditions in the LANSAT data N88-24070
Tornado tracks in Southwestern Brazil, Eastern Paraguay, and Northwestern Argentina N88-24071
Interpretation of MSS/LANDSAT data for evaluation of physical distribution of mangroves in Cananeia-Iguape (SP) N88-24072
Evaluation of an estimation system for an irrigated area in a tropical region through TM-LANDSAT imagery N88-24075
Study of reservoir water quality utilizing remote sensing techniques: Methodological concepts N88-24076
Utilization of LANDSAT-TM imagery in the hydroenergetic inventory of the Paraiba de Sul River Basin N88-24077
Evaluation of the floodable area of the canal of Sao Goncalo through TM-LANDSAT 5 imagery N88-24078
Automatic registration of satellite imagery N88-24080
Visualization of digital terrain models N88-24081
Application of its transformation in color enhancement of LANDSAT imagery N88-24082
Evaluation of a flood period (June, 1984) in the southern region of Laguna dos Patos, through remote sensing data, meteorological and oceanographic N88-24083
Detection of biomass burning and smoke plumes in the Amazon region through NOAA satellite imagery N88-24085
Evaluation of the mangrove area at the Piaui River (SE) through remote sensing N88-24086
Dune fields in central Western Argentina N88-24088
The breaked anticlines, cuesta and crest homoclines, ortoclinal valleys, and other forms of relief outcrops delineated with the help of remote sensing imagery N88-24089
Mapping of plant associations and the variation of surface water in the Pantanal Mato-Grossense National Park, through remote sensing techniques N88-24092
Temporal analysis of the changes in Parque Estadual de Jacupiranga vegetation through digital treatment of LANDSAT imagery N88-24094
Evaluation of TM false color composites for crop discrimination N88-24096
Some geological aspects of the Pirapemas Lineament Belt N88-24099
Lithostructural interpretation of Chapda do Cachimbo (Pa-Am-Mt), based on radar and LANDSAT imagery N88-24100
Research on enhancing the utilization of digital multispectral data and geographic information systems in global habitability studies
[NASA-CR-182799] N88-24101
Terrain classification using SPOT images and the computer system GOP-300
[FOA-C-20677-2.7] N88-24102
Coupling of satellite remote sensing to digitized topographic map to detect changes in land use
[B8735129] N88-24104
Influence of the Yukon River on the Bering Sea
[NASA-CR-182802] N88-24126
SATELLITE NETWORKS
MSAT-X: A technical introduction and status report
[NASA-CR-182921] N88-23933
SATELLITE OBSERVATION
Prospects of satellite wind sensing systems in the years 1995-2000 N88-24004
Latitudinal and seasonal variation of the cloud characteristic parameters and their effects on the cloud classification N88-24005
Estimation of total Outgoing Longwave Radiation (OLR) flux from geostationary meteorological satellite infrared window radiance N88-24006
SATELLITE ORBITS
The prediction of satellite lifetimes
[RAE-TR-87030] N88-23818
SATELLITE SOUNDING
Some problems with regard to the TOVS processing detected by using NOAA-HRPT data check program N88-24009
Processing of HRPT data from the NOAA series satellites N88-24053
Tiros operational vertical sounder (TOVS) and radiosonding in the region N88-24059
SATELLITE TRACKING
A low cost automatic Earth observation satellite tracking ground receiving station N88-23815
SATELLITE-BORNE INSTRUMENTS
Prospects of satellite wind sensing systems in the years 1995-2000 N88-24004
The high-throughput X-ray spectroscopy mission E6889478 MN513835 — ESA program
[ESA-SP-1092] N88-24554
SATURABLE REACTORS
Low power consumption current transducer
[NASA-CASE-NPO-16888-1-CU] N88-23937
SATURATION
Saturation and the limit of jet mixing enhancement by single frequency plane wave excitation: Experiment and theory
[NASA-TM-100882] N88-23732
SCALARS
Existence of periodic solutions in n-dimensional retarded functional differential equations
[RR-325] N88-24221
SCANNERS
Orbital navigation, docking and obstacle avoidance as a form of three dimensional model-based image understanding N88-24194
SCATTEROMETERS
Preparation and execution of calibration measurements for handling of airborne SAR data (AGRISAR)
[ETN-88-92338] N88-23926
SCHOTTKY DIODES
Research investigation directed toward extending the useful range of the electromagnetic spectrum
[AD-A190198] N88-23920
Research investigation directed toward extending the useful range of the electromagnetic spectrum, appendix
[AD-A190199] N88-23921
Novel silicon Schottky barrier infrared imaging arrays N88-24510
SCREEN EFFECT
Sensitivity of F-106B leading-edge-vortex images to flight and vapor-screen parameters
[NASA-TP-2818] N88-23760
SEA ICE
An investigation of Soviet capabilities in extended range arctic ice forecasting
[AD-A191082] N88-24127
Sea ice kinematics: Space and time scales
[AD-A191162] N88-24128
Examples of ice pack rigidity and mobility characteristics determined from ice motion
[AD-A191163] N88-24129
SEA SURFACE TEMPERATURE
Influence of the Yukon River on the Bering Sea
[NASA-CR-182802] N88-24126
SEALERS
Inadequacies of EMI-seal material: A corrosion study N88-23852
SEALS (STOPPERS)
Thermal stress minimized, two component, turbine shroud seal
[NASA-CASE-LEW-14212-1] N88-23978
Botany Facility: Magnetic fluid seal considerations for the centrifuge
[SIRA-A/7373/WP110/MAC004] N88-24138
SEATS
Variable response load limiting device
[NASA-CASE-LAR-12801-1] N88-23982
SEDIMENTS
Satellite remote sensing of turbidity and sediment concentration in Lagoa dos Patos N88-24032
SEGMENTS
Automatic registration of satellite imagery N88-24080
SEISMIC WAVES
The determination of gravity and topography from seismic velocities, accounting for dynamic behavior of the Earth's mantle
[ETN-88-92420] N88-24117

SEISMOLOGY
The determination of gravity and topography from seismic velocities, accounting for dynamic behavior of the Earth's mantle
[ETN-88-92420] N88-24117
SELF CONSISTENT FIELDS
Raychaudhuri equation in the self-consistent Einstein-Cartan theory with spin-density
[NASA-TM-101145] N88-24546
SELF ORGANIZING SYSTEMS
Experiments in isolated digit recognition using the multilayer perceptron
[RSRE-MEMO-4073] N88-23927
SEMICONDUCTOR DEVICES
Development of 20 GHz monolithic transmit modules
[NASA-CR-182134] N88-24539
SEMICONDUCTORS (MATERIALS)
Non-contact temperature measurement requirements for electronic materials processing N88-23898
Real time thermal imaging of high temperature semiconductor melts N88-23914
Preparation of improved PbSnTe thermoelectric alloys and evaluation of their figure of merit
[AD-A191346] N88-24538
Liquid encapsulated float zone process and apparatus
[NASA-CASE-MFS-28144-1] N88-24545
SENSITIVITY
Sensitivity analysis and multidisciplinary optimization for aircraft design: Recent advances and results
[NASA-TM-100630] N88-23766
SENSORS
A comparison of integrated and separate systems for flight control and navigation N88-23779
Fiber waveguide sensors for intelligent materials
[NASA-CR-183028] N88-23968
Design considerations for the development of an implantable sensor for the continuous measurement of glucose in the diabetic patient N88-24159
SEPARATED FLOW
Unsteady flow about cambered plates
[AD-A191226] N88-23945
Accounting for the effects of unsteady, separated boundary layers in transonic two dimensional calculations
[ONERA-RT-30/3064-RY-063-R] N88-23952
Theoretical and experimental investigation of swirl flow phase separators for microgravity applications N88-24335
Experimental investigation of a microgravity separator for two phase mixtures containing small volumes of gas/vapor N88-24468
SEPARATORS
Theoretical and experimental investigation of swirl flow phase separators for microgravity applications N88-24335
Experimental investigation of a microgravity separator for two phase mixtures containing small volumes of gas/vapor N88-24468
SEQUENCING
SSME technology test bed fast shutdown assessment
[NASA-CR-179354] N88-23831
SERVICE LIFE
The effect of titanium reinforcement on the life of positive grids in lead-acid batteries N88-23857
Pioneer 10 and 11 RTG performance update N88-24301
Foil gas bearing system endurance testing dynamic isotope power system N88-24302
AMTEC electrode development N88-24324
Gas-cooled reactor power systems for space N88-24350
Analysis of closed cycle megawatt class space power systems with nuclear reactor heat sources N88-24351
SEYFERT GALAXIES
IUE evidence on the nature of the innermost broad-line region in Seyfert 1 galaxies N88-24552
SHADOWS
Manual for obscuration code with space station applications
[NASA-CR-178099] N88-23931
SHAFTS (MACHINE ELEMENTS)
Angular position measurements at high temperatures and high radiation environments N88-24479
SHAPES
Shape detection in remote sensing through graph isomorphism N88-24028
SHEATHS
Research and development of electrical insulators for thermionic applications N88-24449
SHELLS (STRUCTURAL FORMS)
Preliminary 2-D shell analysis of the space shuttle solid rocket boosters
[NASA-TM-100515] N88-23989
Three-dimensional curved shell and solid-shell transition finite elements with temperature and temperature gradients as primary variables for steady state heat conduction N88-23997
SHIFT REGISTERS
Novel silicon Schottky barrier infrared imaging arrays N88-24510
SHOCK ABSORBERS
Variable response load limiting device
[NASA-CASE-LAR-12801-1] N88-23982
SHOCK WAVES
Efficient implementation of essentially non-oscillatory shock capturing schemes, 2
[NASA-CR-181656] N88-24217
SHORT TAKEOFF AIRCRAFT
A numerical study of the hot gas environment around a STOVL aircraft in ground proximity
[NASA-TM-100895] N88-23729
SHROUDED TURBINES
Thermal stress minimized, two component, turbine shroud seal
[NASA-CASE-LEW-14212-1] N88-23978
SHUTDOWNS
SSME technology test bed fast shutdown assessment
[NASA-CR-179354] N88-23831
SHUTTLE IMAGING RADAR
The Shuttle Imaging Radar B (SIR-B) experiment report
[NASA-CR-182923] N88-23932
Subsurface morphology and geoarchaeology revealed by spaceborne and airborne radar N88-24022
SIGNAL ANALYSIS
Acoustic emission frequency discrimination
[NASA-CASE-MSC-20467-1] N88-23966
SIGNAL PROCESSING
Error control techniques for satellite and space communications
[NASA-CR-182886] N88-23922
Doppler radar with multiphase modulation of transmitted and reflected signal
[NASA-CASE-MSC-18808-1] N88-23923
Processing of HRPT data from the NOAA series satellites N88-24053
Near surface current determined from INPE's satellite-tracked buoy, during 6-26 November, 1985 N88-24058
Angular position measurements at high temperatures and high radiation environments N88-24479
SIGNAL TO NOISE RATIOS
Loran-C monitor correlation over a 92-mile baseline in Ohio N88-23720
SILANES
Polymer precursors for ceramic composites N88-23890
SILICATES
Point defects in irradiated silicates N88-24319
SILICON
Neutron radiation tolerance of Au-activated silicon N88-24316
Improved GaP doped SiGe thermoelectric material N88-24503
Observation of injected silicon in heliotron E N88-24524
SILICON ALLOYS
Preparation of improved PbSnTe thermoelectric alloys and evaluation of their figure of merit
[AD-A191346] N88-24538
SILICON CARBIDES
Structure and mechanical properties of metal matrix composites made using semi-solid processes: The case of the system Al-Si/SiC
[ETN-88-92299] N88-23836
Nondestructive evaluation of structural ceramics N88-23876
Improved silicon carbide for advanced heat engines N88-23879
Strength optimization of alpha-SiC by improved processing N88-23880
Colloidal characterization of silicon nitride and silicon carbide N88-23883
Molten salt corrosion of SiC and Si3N4 N88-23885
Thermal cyclic durability testing of ceramic materials for turbine engines N88-23886
Ceramic matrix composites N88-23888
Polymer precursors for SiC ceramic materials N88-23889
SiC fiber analysis N88-23891
SiC fiber reinforced reaction-bonded Si3N4 composites N88-23892
High frequency ultrasonic characterization of sintered SiC
[NASA-TM-100825] N88-23985
Defects in cubic silicon carbide on silicon N88-24317
SILICON NITRIDES
Nondestructive evaluation of structural ceramics N88-23876
Improved silicon nitride for advanced heat engines N88-23881
Improved processing of Si3N4 N88-23882
Colloidal characterization of silicon nitride and silicon carbide N88-23883
Molten salt corrosion of SiC and Si3N4 N88-23885
Thermal cyclic durability testing of ceramic materials for turbine engines N88-23886
SiC fiber reinforced reaction-bonded Si3N4 composites N88-23892
SIMULATION
Single phase liquid immersion cooling of discrete heat sources in a vertical channel
[AD-A191224] N88-23944
Finite element simulation of the atmosphere's electromagnetic response to charge perturbations associated with lightning N88-24124
SIMULATORS
Development of an airborne facility for advanced avionics research N88-23801
SINGLE CRYSTALS
Defects in cubic silicon carbide on silicon N88-24317
Interaction of slow neutrons with Ge74 single crystals
[DE87-703010] N88-24536
SINGLE-PHASE FLOW
Theoretical prediction of single phase turbulent flow distribution in particulate bed reactors N88-24386
SINTERING
Improved silicon carbide for advanced heat engines N88-23879
Strength optimization of alpha-SiC by improved processing N88-23880
Improved silicon nitride for advanced heat engines N88-23881
Improved processing of Si3N4 N88-23882
High frequency ultrasonic characterization of sintered SiC
[NASA-TM-100825] N88-23985
SITE SELECTION
Utilization of LANDSAT-TM , for aiding in the localization of archeological sites in the state of Sao Paulo N88-24069
SKIN FRICTION
Boundary layer measurements using hot-film sensors N88-23743
SKY RADIATION
Sky radiance distributions for thermal imaging backgrounds
[AD-A191135] N88-24115
SKY SURVEYS (ASTRONOMY)
Survival analysis, or what to do with upper limits in astronomical surveys
[NASA-CR-182936] N88-24551
SMOKE
Detection of biomass burning and smoke plumes in the Amazon region through NOAA satellite imagery N88-24085
SNAP
SNAP-DYN: Proven technology for wear-term, higher power in space N88-24422
SNAP fuel performance N88-24484
SNAP-DYN: Concepts for multikilowatt space power applications N88-24486
SNAP 19
Pioneer 10 and 11 RTG performance update N88-24301
SODIUM
Theoretical studies of solar-pumped lasers
[NASA-CR-182929] N88-23971
SODIUM CHLORIDES
Corrosion of tungsten alloys in marine environments N88-23854
SODIUM HYDROXIDES
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844
SOFTWARE ENGINEERING
The Design, Development and Testing of Complex Avionics Systems
[AGARD-CP-417] N88-23767
The avionics software architecture impact on system architecture N88-23778
Testing complex avionics software: A practical experience N88-23794
Interfacing and integrating hardware and software design systems N88-23796
Software engineering for the British Aerospace Experimental Aircraft Programme (EAP) N88-23798
A software life cycle support environment N88-23800
Implantation of a geo-cartographical information system through microcomputers N88-24064
COMTAL vision one/20 programming processor system from the VAX 11/780 N88-24079
Protection and security mechanisms in the SMITE capability computer
[RSRE-MEMO-4117] N88-24167

Development environment for secure software
[RSRE-87015] N88-24179
Separability and security models --- software
[RSRE-87020] N88-24180
The Environment for Application Software Integration and Execution (EASIE) version 1.0. Volume 4: System installation and maintenance guide
[NASA-TM-100576] N88-24185
Knowledge based system verification and validation as related to automation of space station subsystems: Rationale for a knowledge based system lifecycle N88-24192
TALOS: A distributed architecture for intelligent monitoring and anomaly diagnosis of the Hubble Space Telescope N88-24193
Models and metrics for software management and engineering
[NASA-CR-182953] N88-24200

SOFTWARE TOOLS
The Design, Development and Testing of Complex Avionics Systems
[AGARD-CP-417] N88-23767
Managing advanced avionic system design N88-23783
Advanced development of a cockpit automation design support system N88-23785
Design and development of an avionics system adapted to helicopter missions N88-23786
Testing complex avionics software: A practical experience N88-23794
Developing systems using state-of-the-art CAD/CAM technology N88-23795
Software engineering for the British Aerospace Experimental Aircraft Programme (EAP) N88-23798
Avionics systems: Development method and computer tools N88-23799
A software life cycle support environment N88-23800
Workshops for the design of avionics systems and the development of onboard software N88-23802
Coherent functional development: Key to successful future system integration N88-23803
Automatically generated acceptance test: A software reliability experiment
[NASA-CR-181667] N88-23984
A software design tool for the analysis of robot dynamics properties
[NLR-MP-86064-4] N88-24171
The Environment for Application Software Integration and Execution (EASIE) version 1.0. Volume 4: System installation and maintenance guide
[NASA-TM-100576] N88-24185
Parallel processors and nonlinear structural dynamics algorithms and software
[NASA-CR-182925] N88-24187
Third Conference on Artificial Intelligence for Space Applications, part 2
[NASA-CP-2492-PT-2] N88-24188
Integration of symbolic and algorithmic hardware and software for the automation of space station subsystems N88-24190
Automatic program generation from specifications using PROLOG N88-24196
Graphics software tool for VT terminals (VTGRAPH)
[NASA-TM-100331] N88-24201
Description of graphics translation software between Intergraph and Tektronix systems
[NASA-TM-100335] N88-24202

SOI (SEMICONDUCTORS)
Silicon-on-insulator electronics for a space nuclear power system N88-24461

SOIL EROSION
Soil erosion and causative factors at Vandenberg Air Force Base, California
[NASA-TM-100981] N88-24156

SOIL MOISTURE
Theory of neutron moisture probes and interpretation of measurements in complex soil and water systems N88-23965
An update on remote measurement of soil moisture over vegetation using infrared temperature measurements: A FIFE perspective
[NASA-CR-182926] N88-24109

SOILS
Mapping soil and rock variation from satellite images in the Sahel N88-24023
Indentification of shallow groundwater regions in semi-arid Brazil by remote sensing methods N88-24030
Characteristics of drainage determinations in aerial photographs and relief determination on different scales planialtimetric charts for three soils in the state of Sao Paulo N88-24095
Botany Facility: Problems of water supply, plant nutrients and soil in the Botany Facility
[SIRA-A/7373/WP220/RJS/003] N88-24141

SOLAR ACTIVITY
The gamma-ray spectrometer experiment on the solar maximum mission satellite
[NASA-CR-182977] N88-24569

SOLAR ATMOSPHERE
On the magnetic structure and energy balance of EUV-emitting plasma in the quiet Sun N88-24567

SOLAR CELLS
Optimization of organic Rankine cycles for space station applications N88-24407

SOLAR DYNAMIC POWER SYSTEMS
The multi-disciplinary design study: A life cycle cost algorithm
[NASA-CR-4156] N88-24172
Speculations on future opportunities to evolve Brayton powerplants aboard the space station N88-24258

SOLAR FLARES
The gamma-ray spectrometer experiment on the solar maximum mission satellite
[NASA-CR-182977] N88-24569

SOLAR NEUTRINOS
Stable, heavy, neutral particles in the sun and in toponium decay N88-24568

SOLAR PHYSICS
Stable, heavy, neutral particles in the sun and in toponium decay N88-24568

SOLAR RADIATION
Comparison of the solar radiation estimation method by satellites N88-24055

SOLAR THERMAL PROPULSION
Solar thermal propulsion for orbit transfer vehicles N88-24445

SOLAR-PUMPED LASERS
Theoretical studies of solar-pumped lasers
[NASA-CR-182929] N88-23971
Theoretical studies of solar lasers and converters
[NASA-CR-182927] N88-23972

SOLID PHASES
Microgravity thaw experiment (MITEX) N88-24439

SOLID PROPELLANT ROCKET ENGINES
Preliminary 2-D shell analysis of the space shuttle solid rocket boosters
[NASA-TM-100515] N88-23989

SOLID STATE
Reactor instrumentation and control design and performance simulation for SP-100 N88-24306

SOLID STATE DEVICES
Hermetically sealable package for hybrid solid-state electronic devices and the like
[NASA-CASE-MSC-20181-1] N88-23941

SOLID-SOLID INTERFACES
Friction and wear of ceramics N88-23874

SOLIDS
Thermal and power availability transient responses for the Argonne monolithic solid oxide fuel cell N88-24384

SOLITARY WAVES
Interaction of solitons in single model optical fibres N88-24511

SOUND TRANSMISSION
Sources and levels of background noise in the NASA Ames 40- by 80-foot wind tunnel
[NASA-TM-100077] N88-24239

SOUND WAVES
Refraction in underwater acoustics --- navigation systems
[B8735053] N88-24236
Johnson noise thermometer for high-radiation and high-temperature environments N88-24480

SOVIET SPACECRAFT
Soviet spacecraft engineering research
[FASAC-TAR-3090] N88-23823

SOYBEANS
Spectral behavior of crops through analysis of LANDSAT-TM data N88-24047
Identification of areas cultivated with soybeans in the cerrados regions, through digital processingof satellite images: A methodological approach N88-24048
Evaluation of TM false color composites for crop discrimination N88-24096

SOYUZ SPACECRAFT
The USSR space systems for remote sensing of earth resources and the environment (sensor systems, processing techniques, applications) N88-24035

SPACE
State-of-the-art in true space-time finite element method N88-24215

SPACE BASED RADAR
Parametric analysis of power requirements for space-based radar N88-24260
Space based radar application to air traffic control N88-24262

SPACE COMMUNICATION
Error control techniques for satellite and space communications
[NASA-CR-182886] N88-23922

SPACE DEBRIS
Nuclear-powered space debris sweeper N88-24380

SPACE ERECTABLE STRUCTURES
Bi-stem gripping apparatus
[NASA-CASE-MFS-28185-1] N88-23979

SPACE EXPLORATION
Electromagnetic powered vehicles (EMPV) for Mars exploration N88-24388
Reflectance spectroscopy in planetary science: Review and strategy for the future
[NASA-SP-493] N88-24564

SPACE LABORATORIES
Botany Facility pre-phase C/D. Core payload for EURECA, volume 1
[BF-RP-ER-015-VOL-1] N88-24144

SPACE MISSIONS
Electric propulsion options for the SP-100 reference mission N88-24296

SPACE NAVIGATION
Orbital navigation, docking and obstacle avoidance as a form of three dimensional model-based image understanding N88-24194

SPACE PERCEPTION
Spatial cognition N88-24152

SPACE PLATFORMS
A thermal equilibrium model for multi-megawatt space platforms N88-24332
Individual satellite power requirements calculated from specified constellation performance N88-24392
The effect of maximum allowable payload temperature on the mass of a multimegawatt space based platform N88-24416
Space Power Reference Source (SPRS): A user's guide to SDI Space Power Technology Programs N88-24440
A nuclear powered space based multimegawatt MHD disc power system N88-24471

SPACE POWER REACTORS
Transactions of the Fourth Symposium on Space Nuclear Power Systems
[DE88-006164] N88-24254
Overview of NASA Lewis Research Center free-piston Stirling engine technology activities applicable to space power systems N88-24255
Speculations on future opportunities to evolve Brayton powerplants aboard the space station N88-24258
The results of application studies for space nuclear power N88-24259
Effects of space-dependent cross sections on core physics parameters for compact fast spectrum space power reactors N88-24263
Considerations pertinent to the Doppler effect for space reactors N88-24264
Status of CEA design and simulation studies of a 200 KWe turboelectric space power system N88-24268
Magnet shielding analysis for SOAR: A space fusion reactor N88-24269
A fusion based plasma propulsion system N88-24274
Preliminary study of niobium alloy contamination by transport through helium N88-24279
Fabrication of lithium hydride shields for space nuclear power systems N88-24282
Conceptual design of the SP-100 GES test site N88-24284
Fast critical experiment data for space reactors N88-24286
Fully passive space reactor conceptual design N88-24288
Space based nuclear-pumped laser/reactor concepts N88-24289
Acoustical gas core reactor with MHD power generation for burst power in a bimodal system N88-24290
Fluid dynamics of spherical cavity reactors N88-24291
BIFOLD: A dual-mode nuclear space power system N88-24292
Electric propulsion options for the SP-100 reference mission N88-24296
Interaction of the control system with core nuclear design for fast spectrum space power reactors N88-24304
Application of the reactivity constraint approach to the transient control of spacecraft reactors N88-24305
An adaptive load-following control system for a space nuclear power system N88-24307
The effect of elevated temperature on irradiated MOS devices N88-24308
The response of a power MOSFET (N-channel) and a dielectric isolated operational amplifier to the combined environmental effects of high temperature and total dose gamma radiation N88-24309
Advanced thermionic converter technology for inductive output coupling N88-24311
Monolithic fuel cell based power source for sprint power generation N88-24313
Power source selection for neutral particle beam systems N88-24314

Radiation hardening design of nuclear powered spacecraft N88-24315
Space nuclear reactor shielding optimization studies N88-24320
Design of a high-power-density Ljungstroem turbine using potassium as a working fluid N88-24323
Development of reliable fuel pins for space reactor applications N88-24326
Helium-3 fusion fuel resources for space power N88-24330
Thermal management for multi-modal nuclear power plants N88-24331
A thermal equilibrium model for multi-megawatt space platforms N88-24332
A review of impact design criteria for space power heat rejection systems N88-24333
Fundamental analysis of space nuclear-MHD generator for gigawatt-level power N88-24337
Liquid-metal MHD power conversion for space electric systems N88-24338
Studies for the definition of a Faraday converter for space nuclear systems N88-24339
Design of a superconducting alternator for space-based power generation N88-24340
Progress in the computer modeling of the liquid phase behavior of a liquid metal heat pipe N88-24342
A liquid metal MHD concept for multimegawatt space power application N88-24348
Nuclear Rankine/flywheel MMW space power concept N88-24349
Gas-cooled reactor power systems for space N88-24350
Analysis of closed cycle megawatt class space power systems with nuclear reactor heat sources N88-24351
A dynamic model for the aft accumulator in the TE SP-100 system N88-24354
RSMASS: A simple model for estimating reactor/shield masses N88-24355
SP-100 control system modeling N88-24356
ATHENA simulation of the 300 kW SP-100 N88-24357
Parametric analyses of the TE SP-100 system performance N88-24358
A proposed national policy concerning the reentry of space reactors N88-24359
Nuclear safety as applied to space power reactor systems N88-24360
Development and implementation of a space nuclear safety program N88-24361
Innovative methodology and developments in US space radioisotope power safety risk assessments N88-24362
Inherently safe space reactors N88-24363
Advanced LMMHD space power generation concept N88-24364
SOAR: Space orbiting advanced fusion power reactor N88-24366
Multimegawatt nuclear power system for lunar base applications N88-24367
Radiation effects testing capabilities of the Texas A and M Nuclear Science Center N88-24368
A generalized method for optimizing the mass of space power systems N88-24369
Fabrication of SP-100 fuel barrier structures by chemical vapor deposition N88-24371
SP-100 system modeling: SNPSAM update N88-24372
Fabrication of a niobium 1 percent zirconium containment for SP-100 primary lithium system materials mass transfer studies N88-24373
Transactions of the Fifth Symposium on Space Nuclear Power Systems
[DE88-006165] N88-24374
SP-100 GES test site N88-24375
Civil missions applications study N88-24376
Applications of nuclear power to lunar and Mars missions N88-24377
Air Force space power requirements and nuclear power assessment methodology N88-24378
Nuclear-powered space debris sweeper N88-24380
EETAP (End-to-End Transient Analysis Program) for space nuclear power system simulation N88-24381
Optimization of SP-100 thermoelectric electromagnetic pump N88-24382
Relating design and environmental variables to reliability N88-24383
Power requirements for mining and microwave processing of extraterrestrial resources N88-24389
Power and energy requirements for electromagnetic launchers N88-24391
Possible creep studies of lithium with a compact device N88-24404
Neutronics conceptual design of a UF6-fueled gaseous laser system N88-24405
Preliminary analysis of helium generation and its effects on the SP-100 system performance N88-24406
Optimization of organic Rankine cycles for space station applications N88-24407
Assessment of nuclear reactor concepts for low power space applications N88-24409
United Nations deliberations of the use of nuclear power sources in space: 1978-1987 N88-24410
Discussions and agreements in the United Nations on important issues associated with nuclear power in space N88-24411
Critical nuclear launch issues: A perspective from the State of Florida N88-24412
Space reactor end of life issues N88-24413
SP-100 flight qualification testing assessment N88-24414
Liquid droplet radiator development N88-24415
The effect of maximum allowable payload temperature on the mass of a multimegawatt space based platform N88-24416
Space vehicle/nuclear reactor thermal radiation integration issues N88-24417
MACRAD: A mass analysis code for radiators N88-24418
The Curie point radiator N88-24420
Dynamic isotope power system critical component verification N88-24421
Evaluation of UN fuel pin failure modes and motion of fuel during severe accidents for reactors in space N88-24424
Reactor core coolability with reduced power levels N88-24425
Analysis of a nuclear orbital transfer vehicle reentry accident N88-24426
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites N88-24427
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428
Value assessment of energy storage concepts in burst power systems N88-24432
A multimegawatt space power source radiator design N88-24436
An irradiation performance data base for nitride fuels N88-24438
Liquid metal testing at ETEC for the SP-100 program N88-24446
Review of alkali metal and refractory alloy compatibility for Rankine cycle applications N88-24447
Development of materials for fabric radiators N88-24448
Polymer fuel cell as an energy storage component for space power applications N88-24452
Benchmark physics experiments for SP-100 N88-24453
Trade study for kWe class space reactors N88-24454
A high power density radial-in-flow reactor split core design for space power systems N88-24455
Transient analyses of multimegawatt space reactors N88-24456
MMW shielding design and analysis N88-24457
The NERVA derivative reactor and a systematic approach to multiple space power requirements N88-24458
Ceramic electrical insulator development for thermoelectric SACE power system N88-24459
Apparatus for the measurement of resistivity of glasses and ceramics N88-24460
Silicon-on-insulator electronics for a space nuclear power system N88-24461
Experimental demonstrations of organic Rankine cycle waste heat rejection systems N88-24469
A nuclear powered space based multimegawatt MHD disc power system N88-24471
Burst power gas core reactor with MHD power generation N88-24472
Molybdenum-base cermet fuel development N88-24481
Test plan and facilities for qualifying nuclear rocket fuel elements N88-24482
A comparison of uranium nitride and mixed carbide fuels swelling N88-24485
Energy conversion system optimization study for multimegawatt space nuclear power application N88-24492
Automatic reactor control system for transient operation N88-24493
Experimental evaluation of the MIT-SNL period-generated minimum time control laws for the rapid adjustment of reactor power N88-24494
An optimal disturbance rejection control system for multimegawatt space nuclear power systems N88-24495
SP-100 ground engineering systems test facility control systems N88-24496
TRICE design, evaluation and feasibility tests N88-24498
Multimegawatt power conditioning requirements study N88-24504
Lightweight power bus for a baseload nuclear reactor in space N88-24505

SPACE PROCESSING
On-orbit technology experiment facility definition [NASA-TM-100614] N88-23824
Non-contact temperature measurement requirements for electronic materials processing N88-23898
Noncontact temperature measurement: Requirements and applications for metals and alloys research N88-23899
Multi-color pyrometer for materials processing in space N88-23905
Separation of biological materials in microgravity [NASA-TM-101142] N88-23916
Power requirements for mining and microwave processing of extraterrestrial resources N88-24389
Microgravity thaw experiment (MITEX) N88-24439

SPACE SHUTTLE BOOSTERS
Preliminary 2-D shell analysis of the space shuttle solid rocket boosters [NASA-TM-100515] N88-23989
Effects of natural environment on first generation solid rocket booster thermal protection system materials [NASA-TM-100329] N88-24113

SPACE SHUTTLE MAIN ENGINE
SSME technology test bed fast shutdown assessment [NASA-CR-179354] N88-23831

SPACE SHUTTLE PAYLOADS
The Shuttle Imaging Radar B (SIR-B) experiment report [NASA-CR-182923] N88-23932
High power ion thruster performance N88-24295

SPACE STATION PAYLOADS
Requirements for temperature and species concentration measurements in microgravity combustion experiments N88-23903

SPACE STATION POWER SUPPLIES
Benefits of 20 kHz PMAD in a nuclear space station N88-24256
Operational concerns involving a shadow-shielded nuclear reactor for space station applications N88-24257
Speculations on future opportunities to evolve Brayton powerplants aboard the space station N88-24258
Hydrogen turbines for space power systems: A simplified axial flow gas turbine model N88-24385

SPACE STATION STRUCTURES
LDR structural experiment definition [NASA-TM-100618] N88-23826

SPACE STATIONS
On-orbit technology experiment facility definition [NASA-TM-100614] N88-23824
LDR structural experiment definition [NASA-TM-100618] N88-23826
Locking hinge [NASA-CASE-MSC-21056-1] N88-23827
Manual for obscuration code with space station applications [NASA-CR-178099] N88-23931
Space Station Human Factors Research Review. Volume 1: EVA Research and Development [NASA-CP-2426-VOL-1] N88-24145
Advanced EVA system design requirements study N88-24147
Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research [NASA-CP-2426-VOL-4] N88-24148
Space station proximity operations and window design N88-24149
Spatial cognition N88-24152
Fault diagnosis in orbital refueling operations N88-24154
Third Conference on Artificial Intelligence for Space Applications, part 2 [NASA-CP-2492-PT-2] N88-24188
MTK: An AI tool for model-based reasoning N88-24189
Integration of symbolic and algorithmic hardware and software for the automation of space station subsystems N88-24190
Connecting remote systems for demonstration of automation technologies N88-24191
Knowledge based system verification and validation as related to automation of space station subsystems: Rationale for a knowledge based system lifecycle N88-24192
Status of the organic Rankine cycle for space applications N88-24402
Optimization of organic Rankine cycles for space station applications N88-24407

Research and Technology, 1987, Goddard Space Flight Center N88-24572
SPACE TRANSPORTATION SYSTEM
Technology development program for twenty-first century aerospace vehicles N88-23768
SPACE WEAPONS
Parametric analysis of power requirements for space-based radar N88-24260
Monolithic fuel cell based power source for sprint power generation N88-24313
Analysis of closed cycle megawatt class space power systems with nuclear reactor heat sources N88-24351
The effect of operating temperature on open, multimegawatt space power systems N88-24352
Comparison of open and closed multimegawatt space power systems N88-24353
RSMASS: A simple model for estimating reactor/shield masses N88-24355
Hydrogen turbines for space power systems: A simplified axial flow gas turbine model N88-24385
Power and energy requirements for electromagnetic launchers N88-24391
Individual satellite power requirements calculated from specified constellation performance N88-24392
Candidate advanced energy storage concepts for multimegawatt burst power systems N88-24434
SPACE-TIME FUNCTIONS
Raychaudhuri equation in the self-consistent Einstein-Cartan theory with spin-density [NASA-TM-101145] N88-24546
SPACEBORNE EXPERIMENTS
Noncontact temperature measurements in the microgravity fluids and transport phenomena discipline N88-23901
Microgravity combustion discipline working group summary of requirements for noncontact temperature measurements N88-23902
Requirements for temperature and species concentration measurements in microgravity combustion experiments N88-23903
Non-contact temperature measurements for biotechnology discipline working group N88-23904
Airborne and spaceborne radar images for geologic and environmental mapping in the Amazon rain forest, Brazil N88-24021
Botany Facility pre-phase C/D. Core payload for EURECA, volume 2 [BF-RP-ER-015-VOL-2] N88-24130
Botany Facility: The problems of plant fixation [SIRA-A/7373/WP220/RJS/001] N88-24140
SPACECRAFT COMMUNICATION
Environmental projects. Volume 6: Environmental assessment. New 34-meter antenna at Venus site [NASA-CR-182922] N88-23919
Connecting remote systems for demonstration of automation technologies N88-24191
SPACECRAFT COMPONENTS
TES: A modular systems approach to expert system development for real-time space applications N88-24197
SPACECRAFT CONSTRUCTION MATERIALS
Soviet spacecraft engineering research [FASAC-TAR-3090] N88-23823
SPACECRAFT CONTROL
Technology development program for twenty-first century aerospace vehicles N88-23768
Three axis attitude control system [NASA-CASE-GSC-12970-1] N88-23808
Travelling wave concepts for the modeling and control of space structures [AD-A191235] N88-23819
TALOS: A distributed architecture for intelligent monitoring and anomaly diagnosis of the Hubble Space Telescope N88-24193
Genetic algorithms for adaptive real-time control in space systems N88-24195
SPACECRAFT DESIGN
Technology development program for twenty-first century aerospace vehicles N88-23768
Colombus feasibility studies, executive summary [ETN-88-92334] N88-23820
Advanced EVA system design requirements study N88-24147
Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research [NASA-CP-2426-VOL-4] N88-24148
Space station proximity operations and window design N88-24149
Radiation hardening design of nuclear powered spacecraft N88-24315
A review of impact design criteria for space power heat rejection systems N88-24333
Relating design and environmental variables to reliability N88-24383
SPACECRAFT DOCKING
Orbital navigation, docking and obstacle avoidance as a form of three dimensional model-based image understanding N88-24194
SPACECRAFT LAUNCHING
Direct nuclear propulsion for Earth-to-orbit vehicles N88-24271
SPACECRAFT MANEUVERS
Orbital navigation, docking and obstacle avoidance as a form of three dimensional model-based image understanding N88-24194
SPACECRAFT POWER SUPPLIES
Aerospace energy systems laboratory: Requirements and design approach [NASA-TM-100423] N88-24206
Parametric analysis of power requirements for space-based radar N88-24260
Megawatt level electric propulsion perspectives N88-24294
The Light-Weight Radioisotope Heater Unit (LWRHU): Development and application N88-24299
MHW RTG performance during LES 8/9 and Voyager missions N88-24300
Foil gas bearing system endurance testing dynamic isotope power system N88-24302
Two-phase fluid management for a Rankine cycle isotope power system N88-24303
Reactor instrumentation and control design and performance simulation for SP-100 N88-24306
A review of thermionic power conversion systems for SDI applications N88-24310
Radiation hardening design of nuclear powered spacecraft N88-24315
The effect of operating temperature on open, multimegawatt space power systems N88-24352
Transactions of the Fifth Symposium on Space Nuclear Power Systems [DE88-006165] N88-24374
Air Force space power requirements and nuclear power assessment methodology N88-24378
Thermal and power availability transient responses for the Argonne monolithic solid oxide fuel cell N88-24384
Review of power requirements for satellite remote sensing systems N88-24387
Individual satellite power requirements calculated from specified constellation performance N88-24392
A transient model for liquid metal heat pipes N88-24398
The dynamic isotope power system: Technology status and demonstration program N88-24400
Characteristics of the closed Brayton cycle for dynamic isotope power systems N88-24401
Status of the organic Rankine cycle for space applications N88-24402
Status of modular RTG technology N88-24403
Optimization of organic Rankine cycles for space station applications N88-24407
Energy storage evaluation for burst power applications N88-24430
Energy storage for nuclear burst power systems N88-24431
Candidate advanced energy storage concepts for multimegawatt burst power systems N88-24434
A multimegawatt space power source radiator design N88-24436
The liquid droplet radiator in space: A parametric approach N88-24437
Space Power Reference Source (SPRS): A user's guide to SDI Space Power Technology Programs N88-24440
Gigawatt, closed cycle, vapor core-MHD space power system conceptual design study N88-24473
Critical issues for SOAR: The space orbiting advanced fusion power reactor N88-24474
Comparison of 20-kWe space nuclear power systems: Impact of reactor temperature and technology upon system design and performances N88-24475
Potassium Rankine power system for space power N88-24476
Low cross-section Mo-Nb thermocouples for nuclear application: The state-of-the-art N88-24477
Material property and irradiation performance correlations for nitride fuels N88-24483
SNAP fuel performance N88-24484
SNAP-DYN: Concepts for multikilowatt space power applications N88-24486
The closed Brayton cycle: An energy conversion system for near-term military space missions N88-24488
The effect of operating temperature and turbine blade cooling on Brayton cycle space power systems N88-24489
A combined Rankine/Brayton pulse power cycle N88-24490
Energy conversion system optimization study for multimegawatt space nuclear power application N88-24492
Automatic reactor control system for transient operation N88-24493
Alkali metal thermoelectric converter design for space power systems applications N88-24499
A capillary pumped SHE/AMTEC system N88-24500
High power density electrodes for AMTEC N88-24501
Multimegawatt power conditioning requirements study N88-24504
Lightweight power bus for a baseload nuclear reactor in space N88-24505
SPACECRAFT PROPULSION
Heat transfer in aerospace propulsion [NASA-TM-100874] N88-23957
The results of application studies for space nuclear power N88-24259
History of some direct nuclear propulsion developments since 1946 N88-24270
Interplanetary propulsion using inertial fusion N88-24273
A fusion based plasma propulsion system N88-24274
Ultra high temperature direct propulsion N88-24275
Safety constraints and considerations in the development of nuclear powered propulsion N88-24276
A critique of NERVA based nuclear reactor design and performance for MMW space propulsion applications N88-24297
Gas core reactors for direct nuclear propulsion N88-24442
Status of high power electric propulsion technology N88-24443
SPACECRAFT RADIATORS
Development of a lightweight structure with load bearing capability and high thermal conductance N88-24393
A reflux tube fabric radiator N88-24394
Liquid droplet radiator development N88-24415
Fabric radiators N88-24435
A multimegawatt space power source radiator design N88-24436
The liquid droplet radiator in space: A parametric approach N88-24437
Space power radiation cooled dc transmission line analysis N88-24506
SPACECRAFT REENTRY
A proposed national policy concerning the reentry of space reactors N88-24359
SPACECRAFT STRUCTURES
Travelling wave concepts for the modeling and control of space structures [AD-A191235] N88-23819
Structural acoustics design manual [ESA-PSS-03-1201-ISSUE-1] N88-23821
Insert design handbook [ESA-PSS-03-1202-ISSUE-1] N88-23822
SPACECRAFT TEMPERATURE
MTK: An AI tool for model-based reasoning N88-24189
Heat pump-augmented systems for spacecraft thermal management N88-24419
The Curie point radiator N88-24420
SPATIAL DISTRIBUTION
Anomalies in the vegetation in the Alto Xingu - MT N88-24043
An investigation of Soviet capabilities in extended range arctic ice forecasting [AD-A191082] N88-24127
Sea ice kinematics: Space and time scales [AD-A191162] N88-24128
SPATIAL FILTERING
Generation of thematic maps for updating aeronautical pilot charts utilizing LANDSAT-TM images N88-24062
SPATIAL RESOLUTION
Spatial filtering on digital images N88-24025
SPECIFIC HEAT
Transient analysis of Li and LiH thermal storage spheres N88-24334
SPECIFIC IMPULSE
Megawatt level electric propulsion perspectives N88-24294
High power ion thruster performance N88-24295
Nuclear electric propulsion system: Nuclear plant and thermomechanical conversion system N88-24298
Solar thermal propulsion for orbit transfer vehicles N88-24445
SPECIFICATIONS
The specification and design of a future maritime reconnaissance aircraft N88-23772
Systems engineering technique N88-23776
Modeling of functional specifications for onboard software: Experience with the Rafale avionics system N88-23777
Interfacing and integrating hardware and software design systems N88-23796

Development of complex avionics systems: Experience from French military programs N88-23804
Specification for IBM/IBM compatible 3480 tape cartridge
[NASA-TM-100702] N88-24168

SPECIMENS
Method of radiographic inspection of wooden members
[NASA-CASE-LAR-13724-1] N88-23983

SPECTRAL BANDS
The gamma 1 and gamma 3 bands of (16)O3: Line positions and intensities
[NASA-TM-101162] N88-24541
Line positions and intensities for the gamma 1 + gamma 2 and gamma 2 + gamma 3 bands of (16)O3
[NASA-TM-101161] N88-24542

SPECTRAL METHODS
An efficient parallel algorithm for the simulation of three-dimensional compressible transition on a 20 processor Flex/32 multicomputer
[NASA-CR-178340] N88-23943

SPECTRAL REFLECTANCE
Reflectance spectroscopy in planetary science: Review and strategy for the future
[NASA-SP-493] N88-24564

SPECTRAL SIGNATURES
Analysis of the parameters responsible for the variations of the illumination conditions in the LANSAT data N88-24070

SPECTROMETERS
X-ray spectroscopic diagnostics on JIPPT-IIU and HELIOTRON-E N88-24515

SPECTROSCOPY
Summary report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements --- plasma diagnostics
[IPPJ-861] N88-24512
Helium-like titanium spectra from tokamak plasmas N88-24516
Spectroscopic study of heliotron E plasmas: Stark profile, CXR, poloidal rotation and carbon coating N88-24523
Spectral diagnostics for temperature and density measurements on ATF N88-24525
Spectroscopic data relevant to alpha particle diagnostics N88-24527
Polarization spectroscopy: Prospect and data needs N88-24531
Availability and quality of spectroscopic data and standards for tokamak studies N88-24534
Reflectance spectroscopy in planetary science: Review and strategy for the future
[NASA-SP-493] N88-24564

SPECTRUM ANALYSIS
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24020
Utilization of LANDSAT-TM , for aiding in the localization of archeological sites in the state of Sao Paulo N88-24069
Study of reservoir water quality utilizing remote sensing techniques: Methodological concepts N88-24076
Differential spectral synthesis of the stellar populations in the bulges of spiral galaxies N88-24558

SPEECH RECOGNITION
Investigation of air transportation technology at Massachusetts Institute of Technology, 1986 N88-23716
Experiments in isolated digit recognition using the multilayer perceptron
[RSRE-MEMO-4073] N88-23927
Experimental evaluation of algorithms for connected speech recognition using hidden Markov models
[RSRE-MEMO-4099] N88-23928

SPHERES
The structure and stability of spherically expanding flames N88-23842

SPHERICAL SHELLS
Method and apparatus for growing crystals
[NASA-CASE-MFS-28137-1] N88-24544

SPIN DYNAMICS
Raychaudhuri equation in the self-consistent Einstein-Cartan theory with spin-density
[NASA-TM-101145] N88-24546
Inflation in Einstein-Cartan theory with energy-momentum tensor with spin
[NASA-TM-101164] N88-24547

SPIRAL GALAXIES
Molecular gas in Virgo cluster spiral galaxies N88-24557

SPLINE FUNCTIONS
Application of spline functions to digital image processing
[ETN-88-92194] N88-24218

SPOT (FRENCH SATELLITE)
Terrain classification using SPOT images and the computer system GOP-300
[FOA-C-20677-2.7] N88-24102

SPRINGS (ELASTIC)
Locking hinge
[NASA-CASE-MSC-21056-1] N88-23827

STABILITY
Mechanics of instability-related delimination growth
[NASA-TM-100622] N88-23998
Observations of frontal instabilities on an upwelling filament
[AD-A191051] N88-24122

STAINLESS STEELS
Enhanced emittance of oxidized 304 stainless steel N88-24408

STANDARDIZATION
Interfacing and integrating hardware and software design systems N88-23796

STANDARDS
Unified interchange format for computer data (standard file format)
[ESA-STR-225] N88-24183
Discussions and agreements in the United Nations on important issues associated with nuclear power in space N88-24411

STARCHES
Identification of hydroxypropyl starch hydrolysate components N88-23832

STARK EFFECT
Spectroscopic study of heliotron E plasmas: Stark profile, CXR, poloidal rotation and carbon coating N88-24523

STARS
Research and Technology, 1987, Goddard Space Flight Center N88-24572

STARTING
Possible creep studies of lithium with a compact device N88-24404

STATE ESTIMATION
Estimation of time- and state-dependent delays and other parameters in functional differential equations
[NASA-CR-181663] N88-24164

STATE VECTORS
A state-space approach to discrete-time super-optimal H sup inf control problems
[OUEL-1712/87] N88-24211

STATISTICAL ANALYSIS
Remote sensing techniques in the estimation of the area cultivated with beans, corn, and castor beans in the Irece County (Bahia State) N88-24045
Characteristics of drainage determinations in aerial photographs and relief determination on different scales planialtimetric charts for three soils in the state of Sao Paulo N88-24095
An investigation of Soviet capabilities in extended range arctic ice forecasting
[AD-A191082] N88-24127
Survival analysis, or what to do with upper limits in astronomical surveys
[NASA-CR-182936] N88-24551

STATISTICAL DISTRIBUTIONS
Evaluation of an estimation system for an irrigated area in a tropical region through TM-LANDSAT imagery N88-24075
Evaluation of the floodable area of the canal of Sao Goncalo through TM-LANDSAT 5 imagery N88-24078
Restrictions in activity monitoring through remote sensing N88-24084
The 35 mm vertical aerial photographs for mapping stands of bracatinga in different age classes N88-24087
Preliminary study on the application of digital processing of TM-LANDSAT data in the mapping of apple orchards in Fraiburgo (SC) N88-24093
Some geological aspects of the Pirapemas Lineament Belt N88-24099

STATISTICAL TESTS
On Hotelling's approach to testing for a nonlinear parameter in regression
[AD-A191189] N88-24229

STEADY STATE
Analysis of closed cycle megawatt class space power systems with nuclear reactor heat sources N88-24351
EETAP (End-to-End Transient Analysis Program) for space nuclear power system simulation N88-24381
HTPIPE: A steady state heat pipe analysis program N88-24396

STEAM TURBINES
Design of a high-power-density Ljungstroem turbine using potassium as a working fluid N88-24323

STELLAR ATMOSPHERES
Consistent transport coefficients in astrophysics
[NASA-TM-101154] N88-24560

STELLAR COLOR
Differential spectral synthesis of the stellar populations in the bulges of spiral galaxies N88-24558

STELLAR LUMINOSITY
Differential spectral synthesis of the stellar populations in the bulges of spiral galaxies N88-24558

STELLAR SPECTRA
IUE evidence on the nature of the innermost broad-line region in Seyfert 1 galaxies N88-24552

STELLAR WINDS
Colliding stellar winds in the eclipsing Wolf-Rayet binary V444 Cygni
[NASA-CR-182937] N88-24563

STELLARATORS
Spectral diagnostics for temperature and density measurements on ATF N88-24525

STEREOPHOTOGRAPHY
Stereoscopic photographs, ground and aerial, of trees used in the arborization of Curitiba (PR) N88-24091

STEREOSCOPIC VISION
Television monitor field shifter and an opto-electronic method for obtaining a stereo image of optimal depth resolution and reduced depth distrotion on a single screen
[NASA-CASE-NPO-17249-1-CU] N88-23924

STIFFENING
Local buckling and crippling of composite stiffener sections
[NASA-TM-101133] N88-23840

STIFFNESS
Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness
[NASA-TP-2697] N88-23988

STIMULATED EMISSION
Theoretical studies of solar-pumped lasers
[NASA-CR-182929] N88-23971
Monolithic fuel cell based power source for sprint power generation N88-24313

STIRLING ENGINES
Overview of NASA Lewis Research Center free-piston Stirling engine technology activities applicable to space power systems N88-24255
Fatigue failure of regenerator screens in a high frequency Stirling engine N88-24491

STOCHASTIC PROCESSES
Modeling, filtering and control of stochastic processes --- communication networks
[ENST-87E021] N88-23925
Parallel discrete-event simulation of FCFS stochastic queueing networks
[NASA-CR-181669] N88-24203
Stochasticity in elliptical galaxies
[SER-C-PREPUBL-FASC-20] N88-24556

STORAGE BATTERIES
Candidate advanced energy storage concepts for multimegawatt burst power systems N88-24434

STORAGE TANKS
Examination of methods for pollen storage and dispersal
[TN-RB524-097/86] N88-24134

STOWAGE (ONBOARD EQUIPMENT)
Locking hinge
[NASA-CASE-MSC-21056-1] N88-23827

STRAIN DISTRIBUTION
Development of reliable fuel pins for space reactor applications N88-24326

STRAIN MEASUREMENT
Strain intensity factor approach for predicting the strength of continuously reinforced metal matrix composites
[NASA-TM-100617] N88-23838

STRAKES
Wind-tunnel investigation of actuated forebody strakes for yaw control at high angles of attack N88-23754
Helicopter anti-torque system using fuselage strakes
[NASA-CASE-LAR-13630-1] N88-23809

STRATOSPHERE
Chemical kinetics and photochemical data for use in stratospheric modeling evaluation Number 8
[NASA-CR-182919] N88-24012

STRESS ANALYSIS
A generalized variational method for solving stress intensity factors at cracks on the edge of holes in orthotropic plates
[IC-AERO-87-02] N88-23992
Possible creep studies of lithium with a compact device N88-24404

STRESS CORROSION CRACKING
Stress corrosion cracking properties of Al-Li alloys N88-23853

STRESS INTENSITY FACTORS
Strain intensity factor approach for predicting the strength of continuously reinforced metal matrix composites
[NASA-TM-100617] N88-23838
Hydrogen embrittlement susceptibility of high strength ESR 4340 steel alloys for ballistically resistant/tolerant components N88-23848
Fracture mechanics N88-23877

A generalized variational method for solving stress intensity factors at cracks on the edge of holes in orthotropic plates
[IC-AERO-87-02] N88-23992

STRESS-STRAIN RELATIONSHIPS
Analysis of crack-tip fields in a viscoplastic material N88-23996

STRESS-STRAIN-TIME RELATIONS
Analysis of crack-tip fields in a viscoplastic material N88-23996

STRUCTURAL ANALYSIS
Travelling wave concepts for the modeling and control of space structures
[AD-A191235] N88-23819
Structural acoustics design manual
[ESA-PSS-03-1201-ISSUE-1] N88-23821
Nondestructive Evaluation (NDE) of structural ceramics by photoacoustic microscopy N88-23884
Remote sensing and structural rupture: Application examples in the study of tectonics N88-24050
Analysis and interpretation of image lithostructure: An application of the multiconcept in the metamorphic belt of Sul de Santana da Boa Vista (RS) N88-24051
Study of fracturing for groundwater research in the Sergipe state with remote sensing products N88-24052
Lithostructural interpretation of Chapda do Cachimbo (Pa-Am-Mt), based on radar and LANDSAT imagery N88-24100
The structural analysis of some crystalline and semi-crystalline substances using X-ray and neutron diffraction N88-24540
Analysis of dust grain properties in two star forming regions through comparison of theoretical models to observations N88-24559

STRUCTURAL DESIGN
Insert design handbook
[ESA-PSS-03-1202-ISSUE-1] N88-23822
LDR structural experiment definition
[NASA-TM-100618] N88-23826
Ceramics for turbine engines N88-23873
Gigawatt, closed cycle, vapor core-MHD space power system conceptual design study N88-24473
Small particle bed reactors: Sensitivity to Brayton cycle parameters N88-24487
A combined Rankine/Brayton pulse power cycle N88-24490
Alkali metal thermoelectric converter design for space power systems applications N88-24499
A capillary pumped SHE/AMTEC system N88-24500
Performance of vapor-fed sodium heat engine/AMTEC systems N88-24502
Multimegawatt power conditioning requirements study N88-24504

STRUCTURAL DESIGN CRITERIA
Some design considerations for ceramic components in heat engine applications N88-23875

STRUCTURAL ENGINEERING
Travelling wave concepts for the modeling and control of space structures
[AD-A191235] N88-23819

STRUCTURAL PROPERTIES (GEOLOGY)
Subsurface morphology and geoarchaeology revealed by spaceborne and airborne radar N88-24022
An integrated study of the Alto Paranaiba Kimberlite Province, Minas Gerais, Brazil: A possible tool for diamond exploration N88-24031
Landuse and landform studies of the Mahanadi River Delta with the help of satellite MSS band N88-24033
Remote sensing and structural rupture: Application examples in the study of tectonics N88-24050
Analysis and interpretation of image lithostructure: An application of the multiconcept in the metamorphic belt of Sul de Santana da Boa Vista (RS) N88-24051
Dune fields in central Western Argentina N88-24088
The breaked anticlines, cuesta and crest homoclines, ortoclinal valleys, and other forms of relief outcrops delineated with the help of remote sensing imagery N88-24089
Some geological aspects of the Pirapemas Lineament Belt N88-24099
Lithostructural interpretation of Chapda do Cachimbo (Pa-Am-Mt), based on radar and LANDSAT imagery N88-24100

STRUCTURAL VIBRATION
Structural acoustics design manual
[ESA-PSS-03-1201-ISSUE-1] N88-23821

STRUCTURAL WEIGHT
Assessment of energy storage concepts for use in sprint power N88-24312
RSMASS: A simple model for estimating reactor/shield masses N88-24355
A generalized method for optimizing the mass of space power systems N88-24369

STRUCTURES
Engine structures: A bibliography of Lewis Research Center's research for 1980-1987
[NASA-TM-100842] N88-24002

SUBMILLIMETER WAVES
Balloon-borne three-meter telescope for far-infrared and submillimeter astronomy
[NASA-CR-182924] N88-24550

SUBSONIC SPEED
Integrated Application of Active Controls (IAAC) technology to an advanced subsonic transport project: Program review
[NASA-CR-3880] N88-23763

SUBSTRATES
Monolithic integration on a GaAs substrate of a quarter ring laser and an optical guide coupled by an evanescent wave
[ETN-88-92308] N88-23969

SUCTION
Operational considerations for laminar flow aircraft N88-23748

SUGAR CANE
CANASATE: Sugar cane mapping by satellite N88-24046
Spectral behavior of crops through analysis of LANDSAT-TM data N88-24047
Evaluation of TM false color composites for crop discrimination N88-24096

SULFUR DIOXIDES
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125

SUN
Stable, heavy, neutral particles in the sun and in toponium decay N88-24568

SUPERCONDUCTIVITY
Materials science with muon spin rotation
[NASA-CR-182891] N88-24242
Systematic variation of magnetic-field penetration depth in high-T(c) superconductors studied by muon spin relaxation N88-24243
Coexisting static magnetic ordering and superconductivity in CeCu2.1Si2 found by muon spin relaxation N88-24245
Superconducting thin film vertex detector for SSC (Superconducting Super Collider) applications
[DE88-005951] N88-24535
Method of producing high T(subc) superconducting NBN films
[NASA-CASE-NPO-16681-1-CU] N88-24543

SUPERCONDUCTORS
Materials science with muon spin rotation
[NASA-CR-182891] N88-24242
Coexisting static magnetic ordering and superconductivity in CeCu2.1Si2 found by muon spin relaxation N88-24245
Static magnetic ordering of CeCu2.1Si2 found by muon spin relaxation N88-24246
Design of a superconducting alternator for space-based power generation N88-24340
Lightweight power bus for a baseload nuclear reactor in space N88-24505

SUPERCRITICAL WINGS
Unsteady pressure and structural response measurements of an elastic supercritical wing
[NASA-TM-100591] N88-23756

SUPERHIGH FREQUENCIES
Preparation and execution of calibration measurements for handling of airborne SAR data (AGRISAR)
[ETN-88-92338] N88-23926

SUPERMASSIVE STARS
IUE evidence on the nature of the innermost broad-line region in Seyfert 1 galaxies N88-24552

SUPERNOVAE
Research and Technology, 1987, Goddard Space Flight Center N88-24572

SUPERSONIC AIRCRAFT
PAN AIR analysis of the NASA/MCAIR 279-3: An advanced supersonic V/STOL fighter/attack aircraft
[NASA-TM-86838] N88-23750
The challenges and opportunities of supersonic transport propulsion technology
[NASA-TM-100921] N88-23806

SUPERSONIC COMBUSTION RAMJET ENGINES
Numerical simulation of scramjet inlet flow fields
[NASA-TP-2517] N88-23735

SUPERSONIC FLOW
Multi-body aircraft with an all-movable center fuselage actively controlling fuselage pressure drag
[NASA-CASE-LAR-13511-1] N88-23765
An efficient parallel algorithm for the simulation of three-dimensional compressible transition on a 20 processor Flex/32 multicomputer
[NASA-CR-178340] N88-23943

SUPERSONIC TRANSPORTS
The challenges and opportunities of supersonic transport propulsion technology
[NASA-TM-100921] N88-23806

SURFACE FINISHING
Surface conditioning products as tools for corrosion removal and corrosion prevention N88-23856

SURFACE GEOMETRY
Cylindrical surface profile and diameter measuring tool and method
[NASA-CASE-MFS-28287-1] N88-23959

SURFACE NAVIGATION
Joint University Program for Air Transportation Research, 1986
[NASA-CP-2502] N88-23715

SURFACE PROPERTIES
Thematic mapping utilizing data from the Thematic Mapper sensor of the LANDSAT satellite N88-24060
Analysis of the parameters responsible for the variations of the illumination conditions in the LANSAT data N88-24070

SURFACE ROUGHNESS
Manufacturing requirements N88-23745

SURFACE TEMPERATURE
Infrared radiometric technique in temperature measurement N88-23913
Indentification of shallow groundwater regions in semi-arid Brazil by remote sensing methods N88-24030
The potential impact on atmospheric ozone and temperature of increasing trace gas concentrations
[NASA-CR-182965] N88-24112

SURFACE WATER
Influence of the Yukon River on the Bering Sea
[NASA-CR-182802] N88-24126

SURGES
Application of the reactivity constraint approach to the transient control of spacecraft reactors N88-24305
EETAP (End-to-End Transient Analysis Program) for space nuclear power system simulation N88-24381

SURVEILLANCE RADAR
Development of an airborne facility for advanced avionics research N88-23801

SURVEYS
Study of reservoir water quality utilizing remote sensing techniques: Methodological concepts N88-24076

SURVIVAL
Radiation effects testing capabilities of the Texas A and M Nuclear Science Center N88-24368
Survival analysis, or what to do with upper limits in astronomical surveys
[NASA-CR-182936] N88-24551

SWELLING
Uranium nitride fuel swelling and thermal conductivity correlations N88-24327
A comparison of uranium nitride and mixed carbide fuels swelling N88-24485

SWIRLING
Theoretical and experimental investigation of swirl flow phase separators for microgravity applications N88-24335

SWITCHING CIRCUITS
Neutron effects on the electrical and switching characteristics of NPN bipolar power transistors N88-24463

SYMBOLIC PROGRAMMING
Integration of symbolic and algorithmic hardware and software for the automation of space station subsystems N88-24190

SYNTHESIS (CHEMISTRY)
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844
Polymer precursors for SiC ceramic materials N88-23889

SYNTHETIC APERTURE RADAR
Preparation and execution of calibration measurements for handling of airborne SAR data (AGRISAR)
[ETN-88-92338] N88-23926

SYSTEM EFFECTIVENESS
A low cost automatic Earth observation satellite tracking ground receiving station N88-23815

SYSTEM FAILURES
Modeling of functional specifications for onboard software: Experience with the Rafale avionics system N88-23777
MTK: An AI tool for model-based reasoning N88-24189

SYSTEMS ANALYSIS
Liquid droplet radiator development N88-24415
MACRAD: A mass analysis code for radiators N88-24418
Dynamic isotope power system critical component verification N88-24421

SYSTEMS ENGINEERING
The Design, Development and Testing of Complex Avionics Systems [AGARD-CP-417] N88-23767
Systems for the 21st century N88-23769
Architecture and role of the Sensor Subsystem in future aircraft weapon systems N88-23770
Rapid prototyping of complex avionic system architectures N88-23771
The specification and design of a future maritime reconnaissance aircraft N88-23772
A structured approach to weapon system design N88-23773
Development of a generic architecture N88-23774
Test philosophy of the EH101 integrated avionic N88-23775
Systems engineering technique N88-23776
A comparison of integrated and separate systems for flight control and navigation N88-23779
Development and testing of a predictive methodology for optimization of man-machine interface in future avionics systems N88-23780
A change in system design emphasis: From machine to man N88-23782
Managing advanced avionic system design N88-23783
Psychosensory cockpit ergonomics, advantages of intelligent information systems N88-23784
Design for interoperability (interchangeability) N88-23789
The integration, characterisation and trialling of a modern complex airborne radar N88-23791
Experience in the integration of human engineering effort with avionics systems development N88-23793
Developing systems using state-of-the-art CAD/CAM technology N88-23795
Workshops for the design of avionics systems and the development of onboard software N88-23802
Coherent functional development: Key to successful future system integration N88-23803
Development of complex avionics systems: Experience from French military programs N88-23804
Ariane 4 pyrotechnics system: Definition of the chains and pyrotechnic devices [CNES-88/CT/DRT/TVE/IL/25] N88-23816
Life Support Subsystem (LSS). Concept for the Botany Facility — EURECA [TN-RB524-107/86] N88-24131
Botany Facility: Considerations and analyses of the balancing system philosophy proposed for the BF centrifuge [SIRA-A/7373/WP110/PWF001] N88-24139
Selection of a handling and maintenance option for the SP-100 ground engineering system test N88-24285
The Curie point radiator N88-24420
The high-throughput X-ray spectroscopy mission E6889478 MN513835 — ESA program [ESA-SP-1092] N88-24554

SYSTEMS INTEGRATION
Integrated avionics reliability N88-23723
Rule-based fault-tolerant flight control N88-23725
The Design, Development and Testing of Complex Avionics Systems [AGARD-CP-417] N88-23767
A comparison of integrated and separate systems for flight control and navigation N88-23779
Development and testing of a predictive methodology for optimization of man-machine interface in future avionics systems N88-23780
Crewstation Information and Development System (CIDS) N88-23781
Design for interoperability (interchangeability) N88-23789
The electromagnetic threat to future avionic systems N88-23790
The integration, characterisation and trialling of a modern complex airborne radar N88-23791
Experience in the integration of human engineering effort with avionics systems development N88-23793
A look toward the future of complex avionics systems development using the USAF Test Pilot School's avionics systems test training aircraft N88-23797
Coherent functional development: Key to successful future system integration N88-23803
Space vehicle/nuclear reactor thermal radiation integration issues N88-24417

SYSTEMS SIMULATION
Monte Carlo analysis of lateral collection diode arrays [RSRE-MEMO-4080] N88-23938
Virtual interface environment N88-24153

T

TABLES (DATA)
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Part 4: Aerodynamic data tabulation [NASA-CR-179469] N88-23956

TANDEM MIRRORS
Hot electron diagnostics using X-ray imaging on GAMMA10 N88-24530

TARGET RECOGNITION
Parametric analysis of power requirements for space-based radar N88-24260

TASKS
NASA-Ames workload research program N88-24151
Fault diagnosis in orbital refueling operations N88-24154

TECHNOLOGICAL FORECASTING
Notes on artificial intelligence. Part 1: Technical forecast [FOA-C-30448-3.3-PT-1] N88-24208
Speculations on future opportunities to evolve Brayton powerplants aboard the space station N88-24258

TECHNOLOGIES
On-orbit technology experiment facility definition [NASA-TM-100614] N88-23824

TECHNOLOGY ASSESSMENT
Microelectronics the next fifteen years N88-23792
Soviet spacecraft engineering research [FASAC-TAR-3090] N88-23823
Current stage of remote sensing system for cartographic application N88-24090
Soviet remote sensing research and technology [FASAC-TAR-3130] N88-24108
Teleoperator human factors study [NASA-CR-178930] N88-24162
Applications of nuclear power to lunar and Mars missions N88-24377
The dynamic isotope power system: Technology status and demonstration program N88-24400
Assessment of nuclear reactor concepts for low power space applications N88-24409
Value assessment of energy storage concepts in burst power systems N88-24432
Low cross-section Mo-Nb thermocouples for nuclear application: The state-of-the-art N88-24477
SNAP-DYN: Concepts for multikilowatt space power applications N88-24486
Air Force ultrafast optical electronics center [AD-A191491] N88-24507

TECHNOLOGY TRANSFER
Developing systems using state-of-the-art CAD/CAM technology N88-23795

TECHNOLOGY UTILIZATION
Clinical applications of computerized thermography N88-23915
The results of application studies for space nuclear power N88-24259

TECTONICS
Remote sensing and structural rupture: Application examples in the study of tectonics N88-24050
Some geological aspects of the Pirapemas Lineament Belt N88-24099
Specific features of emanation, temperature and hydrodynamic fields in the epicentral zone of tectonic earthquake [DE88-701140] N88-24114

TELECOMMUNICATION
Development of a generic architecture N88-23774

TELEMETRY
Soviet remote sensing research and technology [FASAC-TAR-3130] N88-24108
TALOS: A distributed architecture for intelligent monitoring and anomaly diagnosis of the Hubble Space Telescope N88-24193

TELEOPERATORS
Teleoperator human factors study [NASA-CR-178930] N88-24162

TEMPERATURE
Analysis of crack-tip fields in a viscoplastic material N88-23996

TEMPERATURE CONTROL
Multi-color pyrometer for materials processing in space N88-23905
The role of fiberoptics in remote temperature measurement N88-23909
Real time thermal imaging of high temperature semiconductor melts N88-23914
MTK: An AI tool for model-based reasoning N88-24189
The effect of elevated temperature on irradiated MOS devices N88-24308
Turbomachinery in space N88-24321
Thermal management for multi-modal nuclear power plants N88-24331
Silicon-on-insulator electronics for a space nuclear power system N88-24461
Low gravity thermal management using dielectrophoretic forces N88-24470
Method and apparatus for growing crystals [NASA-CASE-MFS-28137-1] N88-24544

TEMPERATURE DEPENDENCE
Ultra high temperature direct propulsion N88-24275
High-temperature thermal conductivity of a carbon-bonded carbon-fiber insulation N88-24281

TEMPERATURE DISTRIBUTION
Studies of heat and mass transfer during chemical vapor deposition N88-23953
Tiros operational vertical sounder (TOVS) and radiosonding in the region N88-24059
Specific features of emanation, temperature and hydrodynamic fields in the epicentral zone of tectonic earthquake [DE88-701140] N88-24114
Observations of frontal instabilities on an upwelling filament [AD-A191051] N88-24122
Botany Facility: Test report on breadboard tests for the determination of the heat transfer at the glass disk and of the temperature distribution in the fluorescent tube [BF-TN-ER-053] N88-24136
A thermal equilibrium model for multi-megawatt space platforms N88-24332
An irradiation performance data base for nitride fuels N88-24438

TEMPERATURE EFFECTS
Influence of fiber reinforcement on the vitreous transition temperature of M 10 matrix composites [ONERA-RT-44/7086-M] N88-23835
Polymer precursors for ceramic composites N88-23890
SiC fiber analysis N88-23891
The effect of elevated temperature on irradiated MOS devices N88-24308
Analysis of thermal and radiation effects in materials using the GEMAT process N88-24318
The effect of operating temperature on open, multimegawatt space power systems N88-24352
The response of selected semiconductor technologies to the combined environmental effects of high temperature and total dose gamma radiation N88-24462

TEMPERATURE MEASUREMENT
Noncontact Temperature Measurement [NASA-CP-2503] N88-23895
Radiation thermometry: The measurement problem N88-23896
The NBS scale of radiance temperature N88-23897
Non-contact temperature measurement requirements for electronic materials processing N88-23898
Noncontact temperature measurement: Requirements and applications for metals and alloys research N88-23899
Noncontact temperature measurement in glass and other transparent materials N88-23900
Noncontact temperature measurements in the microgravity fluids and transport phenomena discipline N88-23901
Microgravity combustion discipline working group summary of requirements for noncontact temperature measurements N88-23902
Requirements for temperature and species concentration measurements in microgravity combustion experiments N88-23903
Non-contact temperature measurements for biotechnology discipline working group N88-23904
Multi-color pyrometer for materials processing in space N88-23905
Direct emissivity measurements on liquids and corrections to multi-color pyrometers N88-23906
Common but unappreciated sources of error in one, two, and multiple-color pyrometry N88-23907
Fast optical pyrometry N88-23908
The role of fiberoptics in remote temperature measurement N88-23909
Laser pyrometry N88-23910
Noncontact true temperature measurement, 2 N88-23911
Laser Diagnostics for combustion temperature and species measurements N88-23912
Infrared radiometric technique in temperature measurement N88-23913
Real time thermal imaging of high temperature semiconductor melts N88-23914
Clinical applications of computerized thermography N88-23915
Summary report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements — plasma diagnostics [IPPJ-861] N88-24512

TEMPERATURE MEASURING INSTRUMENTS
Boundary layer measurements using hot-film sensors N88-23743
Noncontact Temperature Measurement [NASA-CP-2503] N88-23895
TEMPERATURE PROFILES
Ion temperature profile measurement using charge exchange recombination spectroscopy on JIPP T-IIU N88-24518
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D N88-24519
TEMPERATURE SCALES
The NBS scale of radiance temperature N88-23897
TEMPORAL RESOLUTION
Fast optical pyrometry N88-23908
TENSILE PROPERTIES
Effects of natural environment on first generation solid rocket booster thermal protection system materials [NASA-TM-100329] N88-24113
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites N88-24427
TENSILE TESTS
Mechanical and structural characterization of aluminum ceramic fibers [ETN-88-92168] N88-23870
Bearing-bypass material system test [NASA-CASE-LAR-13458-1] N88-23967
TENSORS
Inflation in Einstein-Cartan theory with energy-momentum tensor with spin [NASA-TM-101164] N88-24547
TERMINOLOGY
NASA thesaurus: Astronomy vocabulary [NASA-SP-7069] N88-24553
TERRAIN
Visualization of digital terrain models N88-24081
Terrain classification using SPOT images and the computer system GOP-300 [FOA-C-20677-2.7] N88-24102
Digital monoplotting, part 1 [B8735122-PT-1] N88-24106
Digital monoplotting, part 2 [B8735122-PT-2] N88-24107
TERRAIN ANALYSIS
Study of fracturing for groundwater research in the Sergipe state with remote sensing products N88-24052
TEST FACILITIES
Benefits of 20 kHz PMAD in a nuclear space station N88-24256
Requirements and cost considerations for a combined space nuclear reactor test facility N88-24277
Conceptual design of the SP-100 GES test site N88-24284
Selection of a handling and maintenance option for the SP-100 ground engineering system test N88-24285
SP-100 GES test site N88-24375
Liquid metal testing at ETEC for the SP-100 program N88-24446
TEXTURES
Textural features for image classification in remote sensing N88-24027
Remote sensing and structural rupture: Application examples in the study of tectonics N88-24050
THEMATIC MAPPERS (LANDSAT)
Evaluation of an estimation system for an irrigated area in a tropical region through TM-LANDSAT imagery N88-24075
THEMATIC MAPPING
Latin American Symposium on Remote Sensing, 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, volume 1 N88-24013
Utilization of TM/LANDSAT images in the implanted forests mapping in the Mogi-Guacu Region (SP-Brazil) N88-24042
Thematic mapping utilizing data from the Thematic Mapper sensor of the LANDSAT satellite N88-24060
Geometric image correction: An approach for the registration of LANDSAT-TM digital images supported by topographical maps of medium and great scales N88-24061
Generation of thematic maps for updating aeronautical pilot charts utilizing LANDSAT-TM images N88-24062
Utilization of LANDSAT-TM , for aiding in the localization of archeological sites in the state of Sao Paulo N88-24069
Interpretation of MSS/LANDSAT data for evaluation of physical distribution of mangroves in Cananeia-Iguape (SP) N88-24072
Utilization of LANDSAT-TM imagery in the hydroenergetic inventory of the Paraiba de Sul River Basin N88-24077
Evaluation of a flood period (June, 1984) in the southern region of Laguna dos Patos, through remote sensing data, meteorological and oceanographic N88-24083
Evaluation of the mangrove area at the Piaui River (SE) through remote sensing N88-24086
Evaluation of TM false color composites for crop discrimination N88-24096
Presentation of map information on a color display [FOA-C-20687-2.7] N88-24103
THEOREM PROVING
On a classification of problems on sets of bilinear forms by formal polynomials [RR-642-I-IMAG-53-LIFIA] N88-24219
THERMAL ANALYSIS
Thermal remote anemometer system [NASA-CASE-LAR-13508-1] N88-23962
Application of integrated fluid-thermal-structural analysis methods [NASA-TM-100625] N88-24001
Cermet fuel thermal conductivity N88-24329
HTPIPE: A steady state heat pipe analysis program N88-24396
THERMAL BARRIERS (PLASMA CONTROL)
Hot electron diagnostics using X-ray imaging on GAMMA10 N88-24530
THERMAL BUCKLING
A comparison of experimental and calculated thin-shell leading-edge buckling due to thermal stresses [NASA-TM-100416] N88-23999
THERMAL CONDUCTIVITY
High-temperature thermal conductivity of a carbon-bonded carbon-fiber insulation N88-24281
Uranium nitride fuel swelling and thermal conductivity correlations N88-24327
Cermet fuel thermal conductivity N88-24329
Development of a lightweight structure with load bearing capability and high thermal conductance N88-24393
Consistent transport coefficients in astrophysics [NASA-TM-101154] N88-24560
On the magnetic structure and energy balance of EUV-emitting plasma in the quiet Sun N88-24567
THERMAL CONTROL COATINGS
Space vehicle/nuclear reactor thermal radiation integration issues N88-24417
THERMAL DECOMPOSITION
Analysis of thermal and radiation effects in materials using the GEMAT process N88-24318
THERMAL DIFFUSION
The structure and stability of spherically expanding flames N88-23842
THERMAL ENVIRONMENTS
Integration of symbolic and algorithmic hardware and software for the automation of space station subsystems N88-24190
THERMAL INSULATION
High-temperature thermal conductivity of a carbon-bonded carbon-fiber insulation N88-24281
Development of refractory thermocouples for space nuclear power tests N88-24478
THERMAL MAPPING
Real time thermal imaging of high temperature semiconductor melts N88-23914
Clinical applications of computerized thermography N88-23915
Sky radiance distributions for thermal imaging backgrounds [AD-A191135] N88-24115
THERMAL NEUTRONS
Defects in cubic silicon carbide on silicon N88-24317
Interaction of slow neutrons with Ge74 single crystals [DE87-703010] N88-24536
THERMAL PROTECTION
Thermal stress minimized, two component, turbine shroud seal [NASA-CASE-LEW-14212-1] N88-23978
Effects of natural environment on first generation solid rocket booster thermal protection system materials [NASA-TM-100329] N88-24113
THERMAL SHOCK
Fracture mechanics N88-23877
Strength optimization of alpha-SiC by improved processing N88-23880
Ceramic matrix composites N88-23888
THERMAL STABILITY
SiC fiber analysis N88-23891
THERMAL STRESSES
Thermal stress minimized, two component, turbine shroud seal [NASA-CASE-LEW-14212-1] N88-23978
A comparison of experimental and calculated thin-shell leading-edge buckling due to thermal stresses [NASA-TM-100416] N88-23999
THERMIONIC CONVERTERS
Irradiation test results on thermionic fuel element sheath insulators N88-24280
MHW RTG performance during LES 8/9 and Voyager missions N88-24300
A review of thermionic power conversion systems for SDI applications N88-24310
Advanced thermionic converter technology for inductive output coupling N88-24311
AMTEC electrode development N88-24324
Sodium heat engine/AMTEC system experiments N88-24325
Research and development of electrical insulators for thermionic applications N88-24449
High power density alkaline fuel cell technology for MMW space burst power N88-24451
THERMIONIC EMITTERS
A review of thermionic power conversion systems for SDI applications N88-24310
Advanced thermionic converter technology for inductive output coupling N88-24311
THERMIONIC POWER GENERATION
Energy storage for nuclear burst power systems N88-24431
Candidate advanced energy storage concepts for multimegawatt burst power systems N88-24434
THERMOCHEMISTRY
Thermochemical analysis of mass transfer in a NB-1ZR-potassium heat pipe N88-24346
THERMOCOUPLES
Botany Facility. Thermal Control (TC) subsystem test report on experiment container of laboratory model and breadboard centrifuge [BF-TN-ER-061/86] N88-24135
Low cross-section Mo-Nb thermocouples for nuclear application: The state-of-the-art N88-24477
Development of refractory thermocouples for space nuclear power tests N88-24478
THERMODYNAMIC COUPLING
Advanced thermionic converter technology for inductive output coupling N88-24311
THERMODYNAMIC CYCLES
Nuclear electric propulsion system: Nuclear plant and thermomechanical conversion system N88-24298
Studies for the definition of a Faraday converter for space nuclear systems N88-24339
The liquid droplet radiator in space: A parametric approach N88-24437
THERMODYNAMIC EFFICIENCY
Nuclear electric propulsion system: Nuclear plant and thermomechanical conversion system N88-24298
Preparation of improved PbSnTe thermoelectric alloys and evaluation of their figure of merit [AD-A191346] N88-24538
THERMODYNAMIC EQUILIBRIUM
A thermal equilibrium model for multi-megawatt space platforms N88-24332
THERMOELECTRIC GENERATORS
Speculations on future opportunities to evolve Brayton powerplants aboard the space station N88-24258
The Light-Weight Radioisotope Heater Unit (LWRHU): Development and application N88-24299
Pioneer 10 and 11 RTG performance update N88-24301
A review of thermionic power conversion systems for SDI applications N88-24310
Optimization of SP-100 thermoelectric electromagnetic pump N88-24382
Status of modular RTG technology N88-24403
Weldability of general purpose heat source iridium capsules N88-24429
Ceramic electrical insulator development for thermoelectric SACE power system N88-24459
THERMOELECTRIC MATERIALS
Improved GaP doped SiGe thermoelectric material N88-24503
THERMOELECTRIC POWER GENERATION
The results of application studies for space nuclear power N88-24259
MHW RTG performance during LES 8/9 and Voyager missions N88-24300
AMTEC electrode development N88-24324
Sodium heat engine/AMTEC system experiments N88-24325
A dynamic model for the aft accumulator in the TE SP-100 system N88-24354
Parametric analyses of the TE SP-100 system performance N88-24358
SP-100 system modeling: SNPSAM update N88-24372
A nuclear powered space based multimegawatt MHD disc power system N88-24471
Alkali metal thermoelectric converter design for space power systems applications N88-24499
A capillary pumped SHE/AMTEC system N88-24500
High power density electrodes for AMTEC N88-24501
Performance of vapor-fed sodium heat engine/AMTEC systems N88-24502
Preparation of improved PbSnTe thermoelectric alloys and evaluation of their figure of merit [AD-A191346] N88-24538

THERMOELECTRICITY
Preparation of improved PbSnTe thermoelectric alloys and evaluation of their figure of merit
[AD-A191346] N88-24538

THERMOGRAPHY
Clinical applications of computerized thermography N88-23915

THERMOGRAVIMETRY
Analysis of thermal and radiation effects in materials using the GEMAT process N88-24318

THERMOHYDRAULICS
Thermal-hydraulic considerations for particle bed reactors N88-24266
ATHENA heat pipe transient model N88-24344
Transient thermohydraulic heat pipe modeling N88-24347
SP-100 control system modeling N88-24356
ATHENA simulation of the 300 kW SP-100 N88-24357
Expert systems approach to modeling systems with the ATHENA thermal-hydraulics code N88-24365
The THROHPUT code: Thermohydraulic heat pipe modeling N88-24399

THERMOMETERS
Radiation thermometry: The measurement problem N88-23896
Johnson noise thermometer for high-radiation and high-temperature environments N88-24480

THERMONUCLEAR REACTIONS
BIFOLD: A dual-mode nuclear space power system N88-24292

THERMOSETTING RESINS
Cellular thermosetting fluoropolymers and process for making them
[NASA-CASE-GSC-13008-1] N88-23894

THESAURI
NASA thesaurus: Astronomy vocabulary
[NASA-SP-7069] N88-24553

THIN FILMS
Boundary layer measurements using hot-film sensors N88-23743
Superconducting thin film vertex detector for SSC (Superconducting Super Collider) applications
[DE88-005951] N88-24535
Micro-Raman analysis of dielectric optical thin films
[AD-A191228] N88-24537
Method of producing high T(subc) superconducting NBN films
[NASA-CASE-NPO-16681-1-CU] N88-24543

THIN WALLED SHELLS
A comparison of experimental and calculated thin-shell leading-edge buckling due to thermal stresses
[NASA-TM-100416] N88-23999

THREE AXIS STABILIZATION
Three axis attitude control system
[NASA-CASE-GSC-12970-1] N88-23808

THREE BODY PROBLEM
A generic multibody simulation
[NASA-CR-182949] N88-24198

THREE DIMENSIONAL BODIES
Three-dimensional curved shell and solid-shell transition finite elements with temperature and temperature gradients as primary variables for steady state heat conduction N88-23997

THREE DIMENSIONAL FLOW
Numerical simulation of scramjet inlet flow fields
[NASA-TP-2517] N88-23735
An efficient parallel algorithm for the simulation of three-dimensional compressible transition on a 20 processor Flex/32 multicomputer
[NASA-CR-178340] N88-23943
Development and improvement of a code to calculate small, three dimensional, unsteady transonic perturbations
[ONERA-RTS-31/3064-RY-062-R] N88-23951

THREE DIMENSIONAL MOTION
Minimal parameter solution of the orthogonal matrix differential equation
[NASA-TM-4043] N88-24165
A generic multibody simulation
[NASA-CR-182949] N88-24198

THRESHOLD CURRENTS
Total photoionization cross sections of atomic oxygen from threshold to 44.3A
[NASA-CR-182992] N88-24252

THRUST AUGMENTATION
Augmentor performance of an F100 engine model derivative engine in an F-15 airplane
[NASA-TM-86745] N88-23805

TIME
State-of-the-art in true space-time finite element method N88-24215

TIME DEPENDENCE
Analysis of crack-tip fields in a viscoplastic material N88-23996

TIME LAG
Loran-C monitor correlation over a 92-mile baseline in Ohio N88-23720

TIME SERIES ANALYSIS
Comparison of surface current determined from satellite-tracked buoy with shipboard wind data during the 4th Brazilian antarctic expedition, 10-14 March, 1986 N88-24024
Sea ice kinematics: Space and time scales
[AD-A191162] N88-24128

TIMING DEVICES
Parallel binary and parallel coded decimal time code formats
[AD-A190126] N88-24170

TIMOSHENKO BEAMS
Behavior of a two-layered beam under impact loading
[OUEL-1716/87] N88-23993

TIROS OPERATIONAL SATELLITE SYSTEM
Some problems with regard to the TOVS processing detected by using NOAA-HRPT data check program N88-24009

TITANIUM
The effect of titanium reinforcement on the life of positive grids in lead-acid batteries N88-23857

TITANIUM COMPOUNDS
Muon motion in titanium hydride N88-24247

TOKAMAK DEVICES
Ion temperature measurement with spectroscopy in JT-60 N88-24513
X-ray emission from tokamaks N88-24514
X-ray spectroscopic diagnostics on JIPPT-IIU and HELIOTRON-E N88-24515
Helium-like titanium spectra from tokamak plasmas N88-24516
Spectroscopic results from JET: Some examples of data comparison and data needs N88-24517
Tokamak studies of density sensitive line ratios N88-24521
Flux density measurements of neutral iron in TEXTOR with laser induced fluorescence N88-24528
Measurements of Z(sub eff) profile with a visible bremsstrahlung continuum detector array N88-24529
Availability and quality of spectroscopic data and standards for tokamak studies N88-24534

TOLERANCES (MECHANICS)
Manufacturing requirements N88-23745

TOPOGRAPHY
Geometric image correction: An approach for the registration of LANDSAT-TM digital images supported by topographical maps of medium and great scales N88-24061
Criteria for planimetric and altimetric correction of maps restituted from aerial photographs in 1:100,000 scale N88-24097
The determination of gravity and topography from seismic velocities, accounting for dynamic behavior of the Earth's mantle
[ETN-88-92420] N88-24117

TORCHES
Studies of heat and mass transfer during chemical vapor deposition N88-23953
Welding torch gas cup extension
[NASA-CASE-MFS-29252-1] N88-23980

TORNADOES
Tornado tracks in Southwestern Brazil, Eastern Paraguay, and Northwestern Argentina N88-24071

TOROIDS
An introduction to poloidal and toroidal fields
[MITT-54] N88-24232

TORQUE
Helicopter anti-torque system using fuselage strakes
[NASA-CASE-LAR-13630-1] N88-23809

TOXINS AND ANTITOXINS
EURECA Botany Facility. Technical note: Removal of phytotoxins
[SIRA-A/7373/WP220/RJS/005] N88-24143

TRACE CONTAMINANTS
The potential impact on atmospheric ozone and temperature of increasing trace gas concentrations
[NASA-CR-182965] N88-24112
Preliminary study of niobium alloy contamination by transport through helium N88-24279

TRACE ELEMENTS
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125

TRACKING (POSITION)
Comparison of surface current determined from satellite-tracked buoy with shipboard wind data during the 4th Brazilian antarctic expedition, 10-14 March, 1986 N88-24024
A system for determination of wind fields using geostationary meterological satellites N88-24056
Near surface current determined from INPE's satellite-tracked buoy, during 6-26 November, 1985 N88-24058

TRAILING EDGE FLAPS
High-flaps for natural laminar flow airfoils N88-23739
Pressure distributions from subsonic tests of an advanced laminar-flow-control wing with leading- and trailing-edge flaps
[NASA-TM-4040-PT-1] N88-23758

TRAINING AIRCRAFT
A look toward the future of complex avionics systems development using the USAF Test Pilot School's avionics systems test training aircraft N88-23797

TRAJECTORIES
Comparison of surface current determined from satellite-tracked buoy with shipboard wind data during the 4th Brazilian antarctic expedition, 10-14 March, 1986 N88-24024
Tornado tracks in Southwestern Brazil, Eastern Paraguay, and Northwestern Argentina N88-24071

TRANSCENDENTAL FUNCTIONS
Mahler's method in transcendence theory N88-24227

TRANSDUCERS
Low power consumption current transducer
[NASA-CASE-NPO-16888-1-CU] N88-23937
Characterization of noncontact piezoelectric transducer with conically shaped piezoelement
[NASA-CR-4151] N88-23987
Single mode levitation and translation
[NASA-CASE-NPO-16675-1-CU] N88-24241

TRANSFER ORBITS
Solar thermal propulsion for orbit transfer vehicles N88-24445

TRANSFORMATIONS (MATHEMATICS)
Application of its transformation in color enhancement of LANDSAT imagery N88-24082

TRANSIENT OSCILLATIONS
Asymptotics for a system of nonlinearly coupled wave equations with an application to the galloping oscillations of overhead transmission lines
[REPT-87-78] N88-23991

TRANSIENT REACTOR TEST FACILITY
A novel plant protection strategy for transient reactors N88-24423

TRANSIENT RESPONSE
Progress in the computer modeling of the liquid phase behavior of a liquid metal heat pipe N88-24342
Transient thermohydraulic heat pipe modeling N88-24347
Thermal and power availability transient responses for the Argonne monolithic solid oxide fuel cell N88-24384
The THROHPUT code: Thermohydraulic heat pipe modeling N88-24399
Transient analyses of multimegawatt space reactors N88-24456

TRANSITION FLOW
An efficient parallel algorithm for the simulation of three-dimensional compressible transition on a 20 processor Flex/32 multicomputer
[NASA-CR-178340] N88-23943
Modeling of cavitation phenomena in homogeneous flow in transitory regimes in pipes
[ISAL-IDI1-87-15] N88-23948

TRANSITION TEMPERATURE
Influence of fiber reinforcement on the vitreous transition temperature of M 10 matrix composites
[ONERA-RT-44/7086-M] N88-23835
Method of producing high T(subc) superconducting NBN films
[NASA-CASE-NPO-16681-1-CU] N88-24543

TRANSLATING
Description of graphics translation software between Intergraph and Tektronix systems
[NASA-TM-100335] N88-24202

TRANSLATIONAL MOTION
A generic multibody simulation
[NASA-CR-182949] N88-24198

TRANSMISSION LINES
High frequency power distribution system
[NASA-CR-175071] N88-23939
Space power radiation cooled dc transmission line analysis N88-24506

TRANSMISSIONS (MACHINE ELEMENTS)
Magnetic drive coupling
[NASA-CASE-MSC-21171-1] N88-23973

TRANSMITTANCE
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24066

TRANSMITTERS
Development of 20 GHz monolithic transmit modules
[NASA-CR-182134] N88-24539

TRANSONIC FLIGHT
Sensitivity of F-106B leading-edge-vortex images to flight and vapor-screen parameters
[NASA-TP-2818] N88-23760

TRANSONIC FLOW
Development and improvement of a code to calculate small, three dimensional, unsteady transonic perturbations
[ONERA-RTS-31/3064-RY-062-R] N88-23951
Accounting for the effects of unsteady, separated boundary layers in transonic two dimensional calculations
[ONERA-RT-30/3064-RY-063-R] N88-23952
TRANSPARENCE
Noncontact temperature measurement in glass and other transparent materials N88-23900
TRANSPONDERS
Refraction in underwater acoustics --- navigation systems
[B8735053] N88-24236
TRANSPORT AIRCRAFT
Computational wing design studies relating to natural laminar flow N88-23740
Integrated Application of Active Controls (IAAC) technology to an advanced subsonic transport project: Program review
[NASA-CR-3880] N88-23763
TRANSPORT PROPERTIES
Noncontact temperature measurements in the microgravity fluids and transport phenomena discipline N88-23901
Centrifugal acceleration of ions in the polar magnetosphere
[NASA-TM-101148] N88-24120
An evaluation of energy-independent heavy ion transport coefficient approximations
[NASA-TM-101158] N88-24251
TRANSPORT THEORY
Effects of space-dependent cross sections on core physics parameters for compact fast spectrum space power reactors N88-24263
Consistent transport coefficients in astrophysics
[NASA-TM-101154] N88-24560
A benchmark for galactic cosmic ray transport codes
[NASA-TM-101157] N88-24571
TRAVELING WAVE TUBES
Miniature traveling wave tube and method of making
[NASA-CASE-LEW-14520-1] N88-23936
TRAVELING WAVES
Travelling wave concepts for the modeling and control of space structures
[AD-A191235] N88-23819
Asymptotics for a system of nonlinearly coupled wave equations with an application to the galloping oscillations of overhead transmission lines
[REPT-87-78] N88-23991
TREES (MATHEMATICS)
A comparison of supervised maximum likelihood and decision tree classification for crop cover estimation from multitemporal LANDSAT MSS data N88-24014
TREES (PLANTS)
Utilization of TM/LANDSAT images in the implanted forests mapping in the Mogi-Guacu Region (SP-Brazil) N88-24042
Interpretation of MSS/LANDSAT data for evaluation of physical distribution of mangroves in Cananeia-Iguape (SP) N88-24072
Evaluation of the mangrove area at the Piaui River (SE) through remote sensing N88-24086
Stereoscopic photographs, ground and aerial, of trees used in the arborization of Curitiba (PR) N88-24091
TRIANGULATION
Adjustment in photogrammetry: Methods, programs and applications
[B8735130] N88-24105
TRIBOLOGY
Structural Ceramics
[NASA-CP-2427] N88-23872
Ceramics for turbine engines N88-23873
TRITIUM
Helium-3 fusion fuel resources for space power N88-24330
TROPOSPHERE
SAGE 1 and SAM 2 measurements of 1 micron aerosol extinction in the free troposphere
[NASA-CR-182945] N88-24121
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125
TRUSSES
Continuum modeling and dynamic analysis of large truss structures N88-23995
TUBES
Studies of heat and mass transfer during chemical vapor deposition N88-23953
TUNGSTEN
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites N88-24427
TUNGSTEN ALLOYS
Corrosion of tungsten alloys in marine environments N88-23854
TURBIDITY
Satellite remote sensing of turbidity and sediment concentration in Lagoa dos Patos N88-24032
TURBINE BLADES
Vanadic hot corrosion of gas turbine blade coating materials N88-23864
The effect of operating temperature and turbine blade cooling on Brayton cycle space power systems N88-24489
TURBINE ENGINES
Aeropropulsive characteristics of isolated combined turbojet/ramjet nozzles at Mach numbers from 0 to 1.20
[NASA-TP-2814] N88-23757
Ceramics for turbine engines N88-23873
Thermal cyclic durability testing of ceramic materials for turbine engines N88-23886
TURBINE PUMPS
Rotor self-lubricating axial stop
[NASA-CASE-MFS-28273-1] N88-23974
TURBINES
A combined Rankine/Brayton pulse power cycle N88-24490
TURBOFAN ENGINES
Augmentor performance of an F100 engine model derivative engine in an F-15 airplane
[NASA-TM-86745] N88-23805
TURBOGENERATORS
Status of CEA design and simulation studies of a 200 KWe turboelectric space power system N88-24268
Power source selection for neutral particle beam systems N88-24314
Turbomachinery in space N88-24321
Rotating-hoop, pulsed-energy converter N88-24433
TURBULENCE
Surface curvature and pressure gradient effects on turbulent flow: An assessment based on numerical solution of the Reynolds equations N88-23954
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Part 4: Aerodynamic data tabulation
[NASA-CR-179469] N88-23956
Generation of flux tube waves in stellar convection zones. 1: Longitudinal tube waves
[NASA-TM-101152] N88-24561
TURBULENCE EFFECTS
Investigation of intensity and phase fluctuations of an acoustic wave after crossing thermal turbulence
[ETN-88-92542] N88-24238
TURBULENT BOUNDARY LAYER
Natural laminar flow and airplane stability and control N88-23747
Unsteady flow about cambered plates
[AD-A191226] N88-23945
TURBULENT FLOW
Numerical simulation of scramjet inlet flow fields
[NASA-TP-2517] N88-23735
Theoretical prediction of single phase turbulent flow distribution in particulate bed reactors N88-24386
TWO DIMENSIONAL BODIES
Preliminary 2-D shell analysis of the space shuttle solid rocket boosters
[NASA-TM-100515] N88-23989
TWO DIMENSIONAL FLOW
Accounting for the effects of unsteady, separated boundary layers in transonic two dimensional calculations
[ONERA-RT-30/3064-RY-063-R] N88-23952
Surface curvature and pressure gradient effects on turbulent flow: An assessment based on numerical solution of the Reynolds equations N88-23954
TWO FLUID MODELS
ATHENA simulation of the 300 kW SP-100 N88-24357
TWO PHASE FLOW
Modeling of cavitation phenomena in homogeneous flow in transitory regimes in pipes
[ISAL-IDI1-87-15] N88-23948
Pumped two-phase heat transfer loop
[NASA-CASE-MSC-20841-2] N88-23958
Two-phase fluid management for a Rankine cycle isotope power system N88-24303
An experiment to investigate Rankine cycle two-phase microgravity issues N88-24322
ATHENA heat pipe transient model N88-24344
Reduced-gravity two-phase flow experiments in the NASA KC-135 N88-24465
Analysis and interpretation of low gravity boiling experiments in the KC-135 N88-24466
Microgravity two-phase fluid flow pattern modeling N88-24467
Experimental investigation of a microgravity separator for two phase mixtures containing small volumes of gas/vapor N88-24468

U

U.S.S.R.
Soviet remote sensing research and technology
[FASAC-TAR-3130] N88-24108
U.S.S.R. SPACE PROGRAM
The USSR space systems for remote sensing of earth resources and the environment (sensor systems, processing techniques, applications) N88-24035
USSR Space Life Sciences Digest, Issue 17
[NASA-CR-3922(20)] N88-24155
ULTRASONIC TESTS
High frequency ultrasonic characterization of sintered SiC
[NASA-TM-100825] N88-23985
Input-output characterization of fiber composites by SH waves
[NASA-CR-4153] N88-23986
Characterization of noncontact piezoelectric transducer with conically shaped piezoelement
[NASA-CR-4151] N88-23987
ULTRASONIC WAVE TRANSDUCERS
In-flight measurement of ice growth on an airfoil using an array of ultrasonic transducers
[AIAA-PAPER-87-0178] N88-23717
ULTRAVIOLET ASTRONOMY
IUE evidence on the nature of the innermost broad-line region in Seyfert 1 galaxies N88-24552
ULTRAVIOLET SPECTRA
Observation of injected silicon in heliotron E N88-24524
IUE evidence on the nature of the innermost broad-line region in Seyfert 1 galaxies N88-24552
ULTRAVIOLET SPECTROSCOPY
Ion temperature measurement with spectroscopy in JT-60 N88-24513
Spectroscopic results from JET: Some examples of data comparison and data needs N88-24517
Ion temperature profile measurement using charge exchange recombination spectroscopy on JIPP T-IIU N88-24518
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D N88-24519
UNDERWATER ACOUSTICS
Refraction in underwater acoustics --- navigation systems
[B8735053] N88-24236
UNITED NATIONS
United Nations deliberations of the use of nuclear power sources in space: 1978-1987 N88-24410
Discussions and agreements in the United Nations on important issues associated with nuclear power in space N88-24411
UNIVERSITIES
Structural ceramics research N88-23878
Fiber waveguide sensors for intelligent materials
[NASA-CR-183028] N88-23968
Transactions of the Fifth Symposium on Space Nuclear Power Systems
[DE88-006165] N88-24374
UNMANNED SPACECRAFT
Arguments for manned or unmanned spacecraft activities
[REPT-46/87] N88-23813
UNSTEADY AERODYNAMICS
Methodology for matching experimental and computational aerodynamic data
[NASA-TM-100592] N88-23728
Unsteady pressure and structural response measurements of an elastic supercritical wing
[NASA-TM-100591] N88-23756
UNSTEADY FLOW
Unsteady flow about cambered plates
[AD-A191226] N88-23945
Development and improvement of a code to calculate small, three dimensional, unsteady transonic perturbations
[ONERA-RTS-31/3064-RY-062-R] N88-23951
Accounting for the effects of unsteady, separated boundary layers in transonic two dimensional calculations
[ONERA-RT-30/3064-RY-063-R] N88-23952
UPPER ATMOSPHERE
The precipitation of energetic heavy ions into the upper atmosphere of Jupiter
[NASA-TM-101155] N88-24565
UPWELLING WATER
Observations of frontal instabilities on an upwelling filament
[AD-A191051] N88-24122

URANIUM
An irradiation performance data base for nitride fuels N88-24438

URANIUM COMPOUNDS
Uranium nitride fuel swelling and thermal conductivity correlations N88-24327
Evaluation of UN fuel pin failure modes and motion of fuel during severe accidents for reactors in space N88-24424
Material property and irradiation performance correlations for nitride fuels N88-24483
A comparison of uranium nitride and mixed carbide fuels swelling N88-24485

URANIUM FLUORIDES
Neutronics conceptual design of a UF6-fueled gaseous laser system N88-24405

URBAN PLANNING
Analyses of heliport system plans
[DOT/FAA/PM-87/31] N88-23810
Low altitude remote sensing data in the implementation of a mathematical model for the planning of urban equipment networks N88-24074

USER REQUIREMENTS
Solid Earth mission end-to-end data system study
[C04825.08/FR] N88-23811
Practical image analysis using personal computers: The Canadian experience N88-24037
The SAGE geographic analysis system N88-24063
Multimegawatt power conditioning requirements study N88-24504

UTILITIES
The Environment for Application Software Integration and Execution (EASIE) version 1.0. Volume 4: System installation and maintenance guide
[NASA-TM-100576] N88-24185

V

V/STOL AIRCRAFT
A numerical study of the hot gas environment around a STOVL aircraft in ground proximity
[NASA-TM-100895] N88-23729
PAN AIR analysis of the NASA/MCAIR 279-3: An advanced supersonic V/STOL fighter/attack aircraft
[NASA-TM-86838] N88-23750
Flight testing a V/STOL aircraft to identify a full-envelope aerodynamic model
[NASA-TM-100996] N88-23762

VACUUM
High frequency power distribution system
[NASA-CR-175071] N88-23939

VACUUM CHAMBERS
Ion generator and ion application system
[NASA-CASE-MFS-28122-1] N88-24253
Conceptual design of the SP-100 GES test site N88-24284

VANADIUM OXIDES
Vanadic hot corrosion of gas turbine blade coating materials N88-23864

VAPOR DEPOSITION
SiC fiber reinforced reaction-bonded Si3N4 composites N88-23892
Studies of heat and mass transfer during chemical vapor deposition N88-23953
Fabrication of SP-100 fuel barrier structures by chemical vapor deposition N88-24371

VAPORS
Sensitivity of F-106B leading-edge-vortex images to flight and vapor-screen parameters
[NASA-TP-2818] N88-23760
Theoretical studies of Resonance Enhanced Stimulated Raman Scattering (RESRS) of frequency doubled Alexandrite laser wavelength in cesium vapor
[NASA-CR-182871] N88-23841
Method of evaporation
[NASA-CASE-NPO-15609-2] N88-23848
Transient analysis of heat pipe vapor dynamics N88-24341
A compressible vapor flux model for transient heat pipe analysis N88-24343
Transient thermohydraulic heat pipe modeling N88-24347
Heat pipe transient analysis: Vapor dynamics N88-24397

VARIATIONAL PRINCIPLES
A generalized variational method for solving stress intensity factors at cracks on the edge of holes in orthotropic plates
[IC-AERO-87-02] N88-23992

VECTOR SPACES
An introduction to poloidal and toroidal fields
[MITT-54] N88-24232

VEGETATION
Subsurface morphology and geoarchaeology revealed by spaceborne and airborne radar N88-24022
Anomalies in the vegetation in the Alto Xingu - MT N88-24043
Temporal analysis of the changes in Parque Estadual de Jacupiranga vegetation through digital treatment of LANDSAT imagery N88-24094
An update on remote measurement of soil moisture over vegetation using infrared temperature measurements: A FIFE perspective
[NASA-CR-182926] N88-24109

VEGETATIVE INDEX
Evaluation of a burned area and the vegetation regeneration affected by the burning in the Parque Nacional de Brazilia through TM/LANDSAT data N88-24073

VELOCITY
Analysis of crack-tip fields in a viscoplastic material N88-23996

VELOCITY MEASUREMENT
Inflow measurement made with a laser velocimeter on a helicopter model in forward flight. Volume 5: Tapered planform blades at an advance ratio of 0.23
[NASA-TM-100545] N88-23755

VENTILATION
Impact of control errors on the volume/weight demand of the Ventilation and Dryer (VAD) concept --- EURECA Botany Facility
[TN-RB524-006/87] N88-24132

VENUS (PLANET)
Engineering planetary lasers for interstellar communication
[NASA-CR-180780] N88-23825

VERTICAL JUNCTION SOLAR CELLS
Three-dimensional models of conventional and vertical junction laser-photovoltaic energy converters
[NASA-TM-4039] N88-24111

VERTICAL LANDING
A numerical study of the hot gas environment around a STOVL aircraft in ground proximity
[NASA-TM-100895] N88-23729

VERTICAL ORIENTATION
Single phase liquid immersion cooling of discrete heat sources in a vertical channel
[AD-A191224] N88-23944
Observations of frontal instabilities on an upwelling filament
[AD-A191051] N88-24122

VERY LARGE SCALE INTEGRATION
Microelectronics the next fifteen years N88-23792
Interfacing and integrating hardware and software design systems N88-23796
Evolution of a family of image processing systems at INPE N88-24065
Silicon-on-insulator electronics for a space nuclear power system N88-24461

VIBRATION
The Shock and Vibration Digest, volume 20, no. 4 N88-24214

VIBRATION DAMPING
The LDCM actuator for vibration suppression
[NASA-CR-182898] N88-23940
Vibration and control of flexible rotor supported by magnetic bearings
[NASA-TM-100888] N88-23977

VIBRATION TESTS
Adjusting a finite element model using vibration type experimental data. Concept and error detection
[ONERA-RT-7/3313-RY-060-R] N88-24220

VIDEO EQUIPMENT
Reconfigurable work station for a video display unit and keyboard
[NASA-CASE-MFS-26009-1-SB] N88-24163

VINYL POLYMERS
Boundary layer measurements using hot-film sensors N88-23743

VIRGO GALACTIC CLUSTER
Molecular gas in Virgo cluster spiral galaxies N88-24557

VISCOPLASTICITY
Analysis of crack-tip fields in a viscoplastic material N88-23996

VISCOUS FLOW
Numerical method for unsteady viscous-inviscid interaction to calculate buffeting
[ONERA-RSF-02/3617-AY-008-A] N88-23949

VISIBLE INFRARED SPIN SCAN RADIOMETER
VISSR line number monitoring system N88-24008

VISUAL PERCEPTION
Designing for design effectiveness of complex avionics systems N88-23788
Image management research N88-24150

VITRIFICATION
Influence of fiber reinforcement on the vitreous transition temperature of M 10 matrix composites
[ONERA-RT-44/7086-M] N88-23835

VOICE DATA PROCESSING
Experiments in isolated digit recognition using the multilayer perceptron
[RSRE-MEMO-4073] N88-23927

VOLTAGE AMPLIFIERS
Arc lamp power supply using a voltage multiplier
[NASA-CASE-LAR-13202-1] N88-23942

VOLUME
Mining volume measurement system
[NASA-CASE-LAR-13519-1] N88-23963

VORTICES
Study of a system for reducing base drag by controlling vortices
[REPT-87/43] N88-23730
Sensitivity of F-106B leading-edge-vortex images to flight and vapor-screen parameters
[NASA-TP-2818] N88-23760

VORTICITY
Crossflow vorticity sensor
[NASA-CASE-LAR-13436-1-CU] N88-23759

VULNERABILITY
The avionics software architecture impact on system architecture N88-23778

W

WALKING MACHINES
Space spider crane
[NASA-CASE-LAR-13411-1-SB] N88-23828

WALL FLOW
An efficient parallel algorithm for the simulation of three-dimensional compressible transition on a 20 processor Flex/32 multicomputer
[NASA-CR-178340] N88-23943
Surface curvature and pressure gradient effects on turbulent flow: An assessment based on numerical solution of the Reynolds equations N88-23954

WASTE DISPOSAL
Space reactor end of life issues N88-24413

WASTE HEAT
Space vehicle/nuclear reactor thermal radiation integration issues N88-24417
Experimental demonstrations of organic Rankine cycle waste heat rejection systems N88-24469

WATER FLOW
Evaluation of the floodable area of the canal of Sao Goncalo through TM-LANDSAT 5 imagery N88-24078

WATER POLLUTION
Study of reservoir water quality utilizing remote sensing techniques: Methodological concepts N88-24076

WATER QUALITY
Satellite remote sensing of turbidity and sediment concentration in Lagoa dos Patos N88-24032
Study of reservoir water quality utilizing remote sensing techniques: Methodological concepts N88-24076

WATER RESOURCES
Botany Facility: Problems of water supply, plant nutrients and soil in the Botany Facility
[SIRA-A/7373/WP220/RJS/003] N88-24141

WATER TEMPERATURE
Observations of frontal instabilities on an upwelling filament
[AD-A191051] N88-24122

WATER VAPOR
Mathematical modelling of the heat and water vapour transport in the human respiratory tract N88-24160

WAVE EQUATIONS
Asymptotics for a system of nonlinearly coupled wave equations with an application to the galloping oscillations of overhead transmission lines
[REPT-87-78] N88-23991

WAVE INTERACTION
Interaction of solitons in single model optical fibres N88-24511

WAVE PROPAGATION
Investigation of intensity and phase fluctuations of an acoustic wave after crossing thermal turbulence
[ETN-88-92542] N88-24238

WAVE REFLECTION
Input-output characterization of fiber composites by SH waves
[NASA-CR-4153] N88-23986

WAVEGUIDES
Superconducting thin film vertex detector for SSC (Superconducting Super Collider) applications
[DE88-005951] N88-24535

WAVELENGTHS
Dual wavelength holographic interferometry system
[NASA-CASE-MFS-28242-1] N88-23960

WEAPON SYSTEMS
The Design, Development and Testing of Complex Avionics Systems
[AGARD-CP-417] N88-23767
Architecture and role of the Sensor Subsystem in future aircraft weapon systems N88-23770

The specification and design of a future maritime reconnaissance aircraft N88-23772
A structured approach to weapon system design N88-23773
A change in system design emphasis: From machine to man N88-23782
Advanced development of a cockpit automation design support system N88-23785
The electromagnetic threat to future avionic systems N88-23790
Coherent functional development: Key to successful future system integration N88-23803

WEAPONS
Free electron lasers in strategic defense [DE88-007024] N88-24231

WEAR
Friction and wear of ceramics N88-23874

WEAR RESISTANCE
The performance of perfluoropolyalkylether oils under boundary lubrication conditions [AD-A191057] N88-23869

WEATHERING
Investigation of the long term effects of aging on carbon epoxy composites exposed naturally to the weather under cyclic loads. (Results of sampling after 2.5 years). Test report M1-641300 [CEAT-39/M/79-C-M1-641300] N88-23834
Effects of natural environment on first generation solid rocket booster thermal protection system materials [NASA-TM-100329] N88-24113

WEIGHT (MASS)
Impact of control errors on the volume/weight demand of the Ventilation and Dryer (VAD) concept — EURECA Botany Facility [TN-RB524-006/87] N88-24132

WEIGHT REDUCTION
Development of a lightweight structure with load bearing capability and high thermal conductance N88-24393

WELDABILITY
Weldability of general purpose heat source iridium capsules N88-24429

WELDING
Weldability of general purpose heat source iridium capsules N88-24429

WHEAT
Estimation of an area cultivated with wheat from LANDSAT data through a two-phase sampling method N88-24041

WIND DIRECTION
A system for determination of wind fields using geostationary meterological satellites N88-24056

WIND MEASUREMENT
Prospects of satellite wind sensing systems in the years 1995-2000 N88-24004
Comparison of surface current determined from satellite-tracked buoy with shipboard wind data during the 4th Brazilian antarctic expedition, 10-14 March, 1986 N88-24024

WIND PROFILES
A system for determination of wind fields using geostationary meterological satellites N88-24056

WIND SHEAR
Flight penetration of wind shear: Control strategies N88-23727

WIND TUNNEL MODELS
Inflow measurement made with a laser velocimeter on a helicopter model in forward flight. Volume 5: Tapered planform blades at an advance ratio of 0.23 [NASA-TM-100545] N88-23755
Control law parameterization for an aeroelastic wind-tunnel model equipped with an active roll control system and comparison with experiment [NASA-TM-100593] N88-23807

WIND TUNNEL TESTS
Methodology for matching experimental and computational aerodynamic data [NASA-TM-100592] N88-23728
High Reynolds number tests of a Douglas DLBA 032 airfoil in the Langley 0.3-meter transonic cryogenic tunnel [NASA-TM-87663] N88-23734
Full potential methods for analysis/design of complex aerospace configurations [NASA-CR-3982] N88-23736
Wind tunnel testing of low-drag airfoils N88-23741
PAN AIR analysis of the NASA/MCAIR 279-3: An advanced supersonic V/STOL fighter/attack aircraft [NASA-TM-86838] N88-23750
Wind-tunnel investigation of actuated forebody strakes for yaw control at high angles of attack N88-23754
Pressure distributions from subsonic tests of an advanced laminar-flow-control wing with leading- and trailing-edge flaps [NASA-TM-4040-PT-1] N88-23758
Thermal remote anemometer system [NASA-CASE-LAR-13508-1] N88-23962
Sources and levels of background noise in the NASA Ames 40- by 80-foot wind tunnel [NASA-TM-100077] N88-24239

WIND TUNNELS
Sources and levels of background noise in the NASA Ames 40- by 80-foot wind tunnel [NASA-TM-100077] N88-24239

WIND VELOCITY
A system for determination of wind fields using geostationary meterological satellites N88-24056

WINDOWS (APERTURES)
Space station proximity operations and window design N88-24149

WING LOADING
Methodology for matching experimental and computational aerodynamic data [NASA-TM-100592] N88-23728

WING PANELS
Computational wing design studies relating to natural laminar flow N88-23740
Fuel containment, lightning protection and damage tolerance in large composite primary aircraft structures [NASA-CR-3875] N88-23839

WING PLANFORMS
Computational wing design studies relating to natural laminar flow N88-23740

WINGS
Propulsive performance of a lifting flapping wing N88-23733
Sensitivity of F-106B leading-edge-vortex images to flight and vapor-screen parameters [NASA-TP-2818] N88-23760

WIRE
Corrosion and fatique properties of FeCrB/Si metallic glass wires in aqueous environments N88-23855

WIRE CLOTH
Fatigue failure of regenerator screens in a high frequency Stirling engine N88-24491

WOLF-RAYET STARS
Colliding stellar winds in the eclipsing Wolf-Rayet binary V444 Cygni [NASA-CR-182937] N88-24563

WOOD
Method of radiographic inspection of wooden members [NASA-CASE-LAR-13724-1] N88-23983

WORK
Subsea approach to work systems development N88-24146

WORKING FLUIDS
Design of a high-power-density Ljungstroem turbine using potassium as a working fluid N88-24323
Low gravity thermal management using dielectrophoretic forces N88-24470

WORKLOADS (PSYCHOPHYSIOLOGY)
NASA-Ames workload research program N88-24151

WORKSTATIONS
Point accessibility and primary workspace of simple six-link robots N88-23976
The geometric workstation, a new approach for geometric corrections of remotely sensed data N88-24017
Reconfigurable work station for a video display unit and keyboard [NASA-CASE-MFS-26009-1-SB] N88-24163

X

X RAY DIFFRACTION
The structural analysis of some crystalline and semi-crystalline substances using X-ray and neutron diffraction N88-24540

X RAY IMAGERY
Hot electron diagnostics using X-ray imaging on GAMMA10 N88-24530

X RAY SOURCES
A model for the X-ray binary 4U1820-30 [NASA-TM-101143] N88-24562

X RAY SPECTRA
Observation of injected silicon in heliotron E N88-24524

X RAY SPECTROSCOPY
Ion temperature measurement with spectroscopy in JT-60 N88-24513
X-ray emission from tokamaks N88-24514
X-ray spectroscopic diagnostics on JIPPT-IIU and HELIOTRON-E N88-24515
Spectroscopic results from JET: Some examples of data comparison and data needs N88-24517
The high-throughput X-ray spectroscopy mission E6889478 MN513835 — ESA program [ESA-SP-1092] N88-24554

X RAYS
A model for the X-ray binary 4U1820-30 [NASA-TM-101143] N88-24562

X-30 VEHICLE
National aero-space plane: A technology development and demonstration program to build the X-30 [GAO/NSIAD-88-122] N88-23764

XENON CHLORIDE LASERS
Realization of an XeCl laser producing 100W on average [ETN-88-92541] N88-23970

Y

YAWING MOMENTS
Wind-tunnel investigation of actuated forebody strakes for yaw control at high angles of attack N88-23754

YIELD POINT
GARTEUR TP-037: Impact damage tolerance of carbon fiber and hybrid laminates [RAE-TR-87057] N88-23837

Z

ZERO POWER REACTORS
Benchmark physics experiments for SP-100 N88-24453

ZINC OXIDES
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844

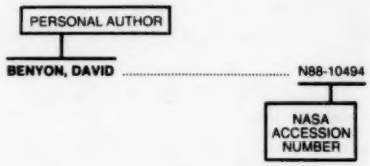
ZINC SELENIDES
Inadequacies of EMI-seal material: A corrosion study N88-23852

ZIRCONIUM
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites N88-24427

ZONAL FLOW (METEOROLOGY)
On regime selection in global atmospheric flow N88-24119

PERSONAL AUTHOR INDEX

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The NASA accession number denotes the number by which the citation is identified.

A

ADU, N. N88-24247
AGARWALA, VINOD S. N88-23851
N88-23852
AHUJA, K. K. N88-23751
N88-23752
N88-23753
AKAOKA, NOBUO N88-24513
AKIYAMA, RYUICHI N88-24533
ALBERT, THOMAS E. N88-24413
ALEMANY, A. N88-24339
ALEXANDER, MICHAEL N88-24503
ALEXION, CHRIS C. N88-24373
ALGER, DONALD L. N88-24491
ALIKIOTIS, DIMITRI N88-23723
ALLEN, A. T. N88-23853
ALLEN, JAMES L. N88-23911
N88-24241
ALLEY, A. D. N88-24306
N88-24356
ALONSO, EDUARDO M. B. N88-24024
N88-24058
ALTHOFF, SUSAN L. N88-23755
ALVIMDEOLIVEIRA, ENI N88-24056
ALVIS, J. M. N88-24329
AMALBERTI, R. N88-23784
AMBROSE, JAY H. N88-24470
AMBROSEK, R. G. N88-24348
AMORETTILISBOA, NELSON N88-24051
ANBAR, MICHAEL N88-23915
ANCTIL, ALBERT A. N88-23848
ANDERSON, B. N88-24274
ANDERSON, VERNON A. N88-23795
ANGEL, G. C. N88-24252
ANGELL, DAVID N88-24227
ANGELO, JOSEPH A., JR. N88-24412
ANGELO, JOSEPH, JR. N88-24359
ANGULOFILHO, R. N88-24095
ANTONIAK, ZENEN I. N88-24435
ANTONIODEANDRADE, LUIS N88-24060
ANTONIODEOLIVO, ACIOLI N88-24074
APARECIDASENAUBARALVES, MARIA N88-24057
APPLIN, ZACHARY T. N88-23758
ARAJ, K. N88-24267
N88-24272
ARAJ, K. J. N88-24266
N88-24275
ARGEMIRODECARVALHOPAIVA, JOAO N88-24081
ARMI, LAURENCE N88-24122
ASBURY, W. L. N88-24283
ASHBY, GEORGE C., JR. N88-23961
ASHIROV, T. A. N88-24114
ASO, TADASHI N88-24005
ASWANI, M. N88-23823
ASWATHANARAYANA, H. N88-24318
ATABAKHCHEFALLAHI, HOMA N88-24207
ATKINSON, C. A. N88-24286
ATTAYA, H. N88-24366
AUDONE, BRUNO N88-23790

B

BAAKLINI, GEORGE Y. N88-23882
N88-23985
BACH, RALPH E., JR. N88-23762
BAGINSKI, MICHAEL EDWARD N88-24124
BAGNALL, CHRIS N88-24373
BAILIN, LIONEL J. N88-23851
BAJER, CZESLAW I. N88-24215
BAJWA, L. Y. N88-23800
BAKER, KARL W. N88-24395
BALES, KAY S. N88-24000
BALLARD, JAN N88-24572
BAMBERGER, S. B. N88-23916
BANERJEE, RANJIT KUMAR N88-24033
BANKS, S. P. N88-24221
BANKSTON, C. P. N88-24324
BANKSTON, C. PERRY N88-24501
BAR-ITZHACK, ITZHACK Y. N88-24165
BARMATZ, MARTIN B. N88-24241
BARRY, R. G. N88-24123
BART, S. N88-24248
BARTH, S. N88-24245
N88-24246
BARTHE, L. N88-24220
BARTRAM, B. W. N88-24361
N88-24362
BASILI, V. R. N88-24200
BATES, JAMES M. N88-24448
BAUMEISTER, E. B. N88-24476
BAYLISS, D. A. N88-24181
BAYOUMI, S. A. N88-23836
BECHTOLD, JOHN KENNETH N88-23842
BEEVIS, D. N88-23793
BEIERSDORFER, P. N88-24514
BELISLE, J. N88-24272
BELL, CHARLES R. N88-24425
BELTRAME, LAWSON N88-24032
BELWARD, A. S. N88-24014
BELWARD, ALAN N88-24023
N88-24032
BELYTSCHKO, TED N88-24187
BENENATI, R. N88-24266
N88-24267
N88-24272
BENENATI, ROBERT F. N88-24386
BENNETT, GARY L. N88-24361
N88-24400
N88-24410
BERARDI, L. N88-23771
BERGER, H. N88-24220
BERGGREN, CHRISTINA N88-23774
BERNARD, JOHN A. N88-24305
N88-24494
BERRETH, J. M. N88-24382
BERRY, MAGGIE L. N88-23983
BERRY, ROBERT L. N88-23983
BESSHOU, S. N88-24523
BEST, FREDERICK N88-24381
BEST, FREDERICK R. N88-24407
N88-24465
N88-24467
BEY, KIM S. N88-24001
BEYER, J. N88-24194
BHATT, RAMAKRISHNA T. N88-23892
BHATTACHARYYA, SAMIT K. N88-24423
N88-24456
N88-24493
BIANCHERIA, A. N88-24326
BIANCO, CARLOS N88-24077
BIDDLE, ALAN P. N88-24253
BILLINGS, S. A. N88-24222
BILTON, J. R. N88-24348
BITTER, M. N88-24514
BLACKBURN, P. E. N88-24450
BLACKMON, J. B. N88-24415
BLACKWELL, JEREMY N88-23733
BLAIR, M. F. N88-23956
BLANC-BENON, PHILIPPE N88-24238
BLAND, T. J. N88-24402
BLAND, TIMOTHY N88-24303
BLAND, TIMOTHY J. N88-24469
BLEILER, KENNETH N88-24460
BLOUNT, DALE H. N88-23974
BLUMENAU, L. N88-24338
BOEHMER, C. B. N88-24441
BOFF, KENNETH R. N88-23788
BOHL, RICHARD J. N88-24270
BOKHARI, S. H. N88-23943
BOLLARD, R. J. H. N88-23878
BOLTAX, A. N88-24326
BOMELBURG, HERBERT J. N88-24490
BONANNI, DAVID L. N88-23840
BONNER, ELLWOOD N88-23736
BONTHOUX, C. G. N88-24215
BOODY, FREDERICK P. N88-24405
BOREK, THEODORE A. N88-24411
BORETZ, JOHN E. N88-24434
BOST, DONALD S. N88-24454
BOUDREAU, JAY E. N88-24270
BOUHERET, DANIEL N88-23786
BOULOUMIE, JEAN-PIERRE N88-23816
BOWMAN, W. JERRY N88-24343
BOY, GUY A. N88-24154
BOYCE, J. N88-23916
BOYLE, DAVID R. N88-24378
BRACKENBURY, P. J. N88-24284
BRADAS, JAMES C. N88-24547
BRADSHAW, C. T. N88-24361
BRADT, R. C. N88-23878
BRANOVER, H. N88-24338
BRASSEUR, G. N88-24112
BREHM, RICHARD N88-24310
BRENTNER, KENNETH S. N88-24240
BREWER, DAVID J. N88-23795
BREWER, E. D. N88-24322
BREWER, J. H. N88-24243
N88-24244
BRIDGE, GORDON N88-24039
BRIEL, U. N88-24554
BRINKMAN, A. C. N88-24554
BRITCLIFFE, MICHAEL J. N88-23946
BRIZUELA, A. N88-24020
N88-24066
BROCKWAY, J. T. N88-24325
BROHLIN, PAUL N88-24381
BROOKS, D. E. N88-23916
BROOME, WILLIAM H., JR. N88-23797
BROWN, C. E. N88-24146
BROWN, D. G. N88-24415
BROWN, DOUGLAS N. N88-24563
BROWN, R. M. N88-24191
BROWN, W. H. N88-23751
N88-23752
N88-23753
BROWNE, J. C. N88-24231
BROZAK, DAN E. N88-24483
BROZAK, DANIEL E. N88-24438
BRUCE, BILL N88-24034
N88-24037
BRUCKNER, A. P. N88-24367
BRYAN, CHARLES F., JR. N88-23828
BRYANT, D. N88-24274
BRYNSVOLD, G. V. N88-24306
BUCHAN, ROBERT W. N88-23824
BUCKLEY, DONALD H. N88-23874
BUCKLEY, ROBIN R. N88-23815
BUCKNER, GERALD L. N88-24437
BUDEN, DAVID N88-24276
N88-24331
N88-24359
N88-24492
BUI, MINH H. N88-23734
BUITKAMP, H. N88-23779
BUNSELL, A. R. N88-23870
BURCHAM, FRANK W., JR. N88-23805
BURGIN, KAREN C. N88-24380
BURKE, W. R. N88-24183
BURRELL, K. H. N88-24519
BUSCH, D. E. N88-24313
N88-24450
BUTTERWORTH, JOEL B. N88-24156
BYERS, DAVID C. N88-24443

C

CABRAL, MARIA ROSELI N88-24053
N88-24059
CACACE, RALPH N88-24197
CAIME, WILLIAM J. N88-24262
CALLOW, R. A. N88-24365
CAMPBELL, J. J. N88-24408
CAMY-PEYRET, C. N88-24541
CANAVAN, G. H. N88-24231
CANYPEYRET, C. N88-24542
CAPPELLETTI, CARLOS A. N88-24041
CARCIELLO, N. N88-23849
CARDOSODELIMA, MARIO IVAN N88-24100
CARELLI, MARIO D. N88-24420
CARIAMORAES, ELISABETE N88-24055
CARLOSDEALMEIDA, FAUSTO N88-24055
N88-24057
CARLSON, LARRY W. N88-24384
CARLSON, TOBY N. N88-24109
CARLSON, W. F. N88-24284
CARLSON, WILLIAM F. N88-24496
CARPENTER, DAVID N88-24381
CARPENTER, STUART G. N88-24453
CARRAWAY, DEBRA L. N88-23743
N88-23759
CARRE, DAVID J. N88-23869
CARRE, F. N88-24266
N88-24475
CARROLL, DAVID W. N88-24371
CARSON, GEORGE T., JR. N88-23757
CARTER, EDWARD L. N88-23973
CASADO, C. MARINEZ N88-24020
CASADO, C. MARTINEZ N88-24066
CASAGRANDE, R. D. N88-24261
CATTON, IVAN N88-24341
N88-24342
CAUBET, M. R. N88-24019
CAUBET, R. N88-24063
CELSODECARVALHO, VITOR N88-24049
CEZAIRLIYAN, ARED N88-23908
CHAN, CHIANG LIU N88-24099
CHAN, T. S. N88-24321
CHAO, B. FONG N88-24118
CHASE, R. R. P. N88-24108
CHATELIN, PHILIPPE N88-24219
CHATURVEDI, ARVIND N88-24031
CHAUDOURNE, S. N88-24475
CHAVEZ, M. N88-24025
CHEESEMAN, PETER N88-24230
CHEN, S. N88-24222
CHEN, SHERRY C. N88-24075
CHEN, SHERRY CHOU N88-24047
CHEN, X. R. N88-24228
CHENG, LI-JEN N88-24508
CHI, J. W. H. N88-24458
CHI, JOHN W. H. N88-24314
CHISHOLM, WILLIAM L. N88-24253
CHIU, W. S. N88-24321
CHO, T. N88-24530
CHOI, MANSOO N88-23953
CHOUDRY, A. N88-24195
CHOW, HUEIMING N88-24344
CHOW, LOUIS C. N88-24470
CHRIEN, R. E. N88-24248
CHRISTIAN, JOSE L., JR. N88-24388
CHRISTY, CRAIG N88-24291
CHUPP, E. L. N88-24569
CICIVIZZO, VITALINA PAGLIUCA N88-24069
CIMINO, JO BEA N88-23932
CINQUIN, PHILIPPE N88-24218
CLARKE, D. W. N88-24209
CLARKE, J. T. N88-24566
CLAUS, JOSEPH J. N88-23856
CLAUS, R. O. N88-23968
CLEARWATER, YVONNE A. N88-24148
CLEMENTEEICK, NILO N88-24051
CLEVELAND, J. C. N88-24363
CLINARD, FRANK W., JR. N88-24449
CLODFELTER, KENNETH N88-24303
COHEN, MARC M. N88-24145
N88-24148
COHEN, ROBERT N88-23925
COINER, JOHN R. N88-24487
COLBAUGH, RICHARD D. N88-24497
COLE, J. E., III N88-24233
COLE, KEVIN N88-24377
COLE, T. N88-24324
COLE, TERRY N88-24501
COLLINS, EMMANUEL GYE, JR. N88-24225
COLLINS, P. J. N88-24286
CONFORTE, JORGE CONRADO N88-24057
CONN, D. W. N88-24361
COOK, ANNELIESE N88-23928
COOMES, EDMUND P. N88-24323
N88-24340
COONS, W. C. N88-24278
COOPER, R. C. N88-24498
CORRADINI, M. L. N88-24366
COSTELLO, DANIEL J., JR. N88-23922
COSTELLO, FREDERICK A. N88-24345
COURSIMAULT, ANTOINE N88-23804
COUTAZ, JEAN LOUIS N88-24509
COVAN, MARK N88-24202
COWAN, C. L. N88-24265
COWAN, D. L. N88-24319
COX, CARL M. N88-24375
CRANATA, RICHARD D. N88-23859
CRANDALL, D. L. N88-24287
CRAVENS, T. E. N88-24565
N88-24566
CRAWLEY, E. F. N88-23823
CREESE, C. N88-24274
CREW, JOHN H., JR. N88-23967
CRUSE, BRYANT G. N88-24193
CUI, DE-YU N88-23992
CULL, T. A. N88-24299
CUMMINGS, GARTH E. N88-24360
CURRIE, JAMES R. N88-23959
CURRY-HYDE, HENRY EDWARD N88-23844
CUTA, JUDITH M. N88-24465
N88-24466
CUTTER, M. A. N88-24137
N88-24138

D

DACRES, C. M. N88-23854
DAGHER, MOHAMMED N88-24291
DAHLBERG, RICHARD C. N88-24310
DALLEMAND, JEAN FRANCOIS N88-24047
DANTASBITENCOURTPEREIRA, MARISA N88-24076
DASILVA, CARLOS L., JR. N88-24024
DAVIES, G. A. O. N88-23992
DAVIES, S. M. N88-24285
DAVIS, A. P. N88-23938
DAVIS, DANIEL N88-23796
DAVIS, KEITH A. N88-24302
N88-24488
DAVIS, R. F. N88-24317
DAVISKAS, EVANGELIA N88-24160
DEAN, KENNESON G. N88-24126
DEARAUJO, CARLOS ALBERTO G. N88-24062
DEBLON, F. N88-23784
DECHAUMPHAI, PRAMOTE N88-24001
DECK, PHILIP D. N88-23859
DEEPAK, A. N88-24121
DEES, D. W. N88-24313
N88-24450
DEFRANCA, G. V. N88-24095
DEFREITAS, M. I. C. N88-24090
DEHART, MARK DAVID N88-24332
DEHOYOS, A. N88-24014
DEKORTE, P. A. J. N88-24554
DELAPORTE, PH. N88-23970
DELCOURT, D. N88-24120
DELIMA, ANGELA MARIA N88-24096
DELOUDESNEVESDEOLIVEIRAKURKDJIAN, MARIA
N88-24074
DELOURDESBUENOTRINDADE, MARIA N88-24043
DEMATOSMEDEIROS, VALDER N88-24054
DEMETRIO, V. A. N88-24095
DEMORE, W. B. N88-24012
DEMOURAABDON, MYRIAN N88-24086
DENNER, WARREN W. N88-24128
N88-24129
DENTON, JUDITH S. N88-24188
DEOLIVEIRASCHUCK, MARISA T. G. N88-24051
DERUDDER, A. N88-24112
DESEM, CAN N88-24511
DESILVA, A. J. S. N88-24205
DESIPIO, RICHARD G. N88-23769
DESPLAT, J.-L. N88-24311
DESSOUKY, KHALED N88-23933
DETERMAN, W. R. N88-24486
DETERMAN, WILLIAM R. N88-24476
DETMAR, F. N88-24105
DEVI, V. MALATHY N88-24541
N88-24542
DEY, DIPAK K. N88-24216
DHIR, VIJAY N88-24364
DHIR, VIJAY K. N88-24335
N88-24393
N88-24468
DIAZ, FRANKLIN CHANG N88-24273
DICARLO, JAMES A. N88-23888
DINER, DANIEL B. N88-23924
DISPERATI, ATTILIO ANTONIO N88-24087
N88-24091
DISTEFANO, JAMES R. N88-24447
DJORDJEVIC, V. N88-24274
DJORDJEVIC, VLADIMIR N88-24381
DOBRANICH, DEAN N88-24416
DOBSON, JESSE C. N88-24449
DOCOUTO, HILTON T. Z. N88-24042
DODGE, RYAN E. N88-24323
DODGE, RYAN E., JR. N88-24340
DOMACK, CHRISTOPHER S. N88-23745
DOREMUS, ROBERT H. N88-23900
DOREY, G. N88-23837
DOSTER, JOSEPH M. N88-24347
N88-24399
DOWDY, JAMES F., JR. N88-24567
DRAPER, SUSAN L. N88-24503
DREIFUS, L. S. N88-24260
DRESS, DAVID A. N88-23734
DRESSENDORFER, P. V. N88-24308
DRING, R. P. N88-23956
DRUBKA, R. E. N88-24415
DUFRESNE, EUGENE R. N88-23846
DUGAN, E. T. N88-24290
DUGAN, EDWARD T. N88-24472
DULKA, C. P. N88-24318
DUNN, H. J. N88-23807
DUPAS, FRANCISCO A. N88-24097
DURAND, A. N88-23934
DUSEK, J. N88-24313
N88-24450
DUTRA, LUCIANO VIEIRA N88-24067
N88-24082
DUTTA, SUNIL N88-23880
DYER, ROBERT C. N88-24071
DZHOLOS, L. V. N88-24114

E

EASLER, T. E. N88-24313
N88-24450
EATHERLY, W. P. N88-24281
EATON, D. C. G. N88-23821
EBEL, A. N88-24232
ECKBRETH, ALAN C. N88-23912
ECKER, ANDREAS N88-23960
ECKSTROM, CLINTON V. N88-23756
EDELSTEIN, FRED N88-23958
EDENBURN, M. W. N88-24352
N88-24353
EDENBURN, MICHAEL W. N88-24489
EDWARDS, D. K. N88-24415
EDWARDS, JAMIE S. N88-23720
EDWARDS, P. A. N88-24284
EHSANI, MEHRDAD N88-24381
EL-BOHER, A. N88-24338
EL-GENK, MOHAMED S. N88-24254
N88-24307
N88-24320
N88-24327
N88-24354
N88-24358
N88-24372
N88-24374
N88-24398
N88-24406
N88-24485
N88-24492
EL-GUEBALY, L. A. N88-24366
N88-24474
EL-GUEBALY, LAILA A. N88-24269
ELLINGSON, W. A. N88-24313
N88-24450
ELLIOT, S. J. N88-24237
ELLIOTT, JOE W. N88-23755
ELLWOOD, J. M. N88-24554
ELSON, JAY S. N88-24425
EMERY, V. J. N88-24243
EMMERT, G. A. N88-24366
N88-24474
ENGLAND, BRENDA N88-24197
ENGLEBRETSON, RONALD E. N88-24129
ENGLEHART, R. W. N88-24361
N88-24362
ENGLISH, ROBERT E. N88-24258
ERDMAN, CARL N88-24381
ERICKSON, LARRY L. N88-23750
ERICKSON, WILLIAM K. N88-24189
ERLEBACHER, G. N88-23943
ERNST, DONALD M. N88-24500
ERTHAL, GUARACI JOSE N88-24062
N88-24061
ERUP, L. N88-24183
ESPINDOLA, CARMEN REGINA S. N88-24086
ETHRIDGE, J. L. N88-24284
EUBANKS, DANA L. N88-24407
EVANS, C. BRAD N88-24372

F

FACEMIRE, BARBARA R. N88-24545
FAGET, NANETTE N88-24407
FAGG, MARY F. N88-24163
FARMER, J. W. N88-24317
FARRUKH, U. O. N88-24121
FAVRE, J. P. N88-23835
FAZIO, GIOVANNI G. N88-24550
FEBER, ROY C. N88-24346
FEE, D. C. N88-24313
N88-24450
FEIGELSON, ERIC D. N88-24551
FEKE, DONALD L. N88-23883
FELGUEIRAS, CARLOS ALBERT N88-24081
FENNELLY, A. J. N88-24546
N88-24547
FERNANDEZ, SEVERINO N88-24028
FERRANDO, W. A. N88-23857
FERROFONTAN, C. N88-24560
FILHO, AUGUSTO PAIVA N88-24077
FILHO, MARIO VALERIO N88-24075
FILHO, PEDRO HERNANDEZ N88-24016
N88-24043
N88-24073
N88-24094
FINK, R. K. N88-24365
FINN, J. M. N88-24248
FIRSTENBERG, H. N88-24362
FISCHER, ERNEST ULRICH N88-24062
FISCHER, W. N88-24135
N88-24136
FISHER, SCOTT S. N88-24153
FITZGERALD, T. J. N88-24369
FLANDERMEYER, B. K. N88-24313
N88-24450
FLAUD, J.-M. N88-24541
N88-24542
FLAX, A. R. N88-23968
FLEETWOOD, D. M. N88-24308
FLEETWOOD, DANIEL M. N88-24461
FLETCHER, E. N88-23935
FLYNN, GEORGE W. N88-23920
N88-23921
FONTAINE, B. N88-23970
FONTENLA, JUAN M. N88-24560
FORBES, ALISTAIR B. N88-24223
FORD, CHARLES R. N88-24445
FORD, JOHN N88-24015
FORD, JOHN P. N88-24021
N88-24044
FORD, P. J. W. N88-24139
FORESTIER, B. N88-23970
FOSTER, PAULO ROBERTO N88-24059
FOSTER, STEPHEN JAMES N88-24540
FOTE, A. N88-23935
FOTH, W. P. N88-24132
FOURGASSIE, ALAIN N88-24116
FOUSEK, R. J. N88-24313
N88-24450
FOX, D. S. N88-23885
FRASCA, ALBERT J. N88-24463
FRASER, G. W. N88-24554
FRASER, R. S. N88-24108
FRAZIER, DONALD O. N88-24544
N88-24545
FREEMAN, MICHAEL S. N88-24188
FRETWELL, P. N88-24181
N88-24182
FRIED, WALTER R. N88-23787
FRIEDLANDER, ALAN N88-24377
FRISBIE, F. R. N88-24146
FRISH, MICHAEL B. N88-23905
FUJIMOTO, TAKASHI N88-24522
N88-24531
FUJITA, J. N88-24512
FUNSTEN, H. O. N88-24248
FURGAL, DAVID T. N88-24504

G

GAA, FLORENCIO O. N88-23955
GABRIEL, EDWARD A. N88-23749
GAETA, MICHAEL N88-24381
GALLI, E. N88-23775
GALLUP, D. R. N88-24353
GALLUP, DONALD R. N88-24418
GARIBOTTI, J. F. N88-23823
GARNER, J. K. N88-24369
GARRELICK, J. M. N88-24233
GARSHNEK, VICTORIA N88-24155
GATES, RICHARD M. N88-23824
N88-23826
GAUDET, L. N88-23731
GAY, RICHARD L. N88-24282
GEDEON, STEPHEN R. N88-24409
GELDARD, LLOYD N88-23871
GELFAND, ALAN E. N88-24216
GENERAZIO, EDWARD R. N88-23985
GENTRY, GARL L., JR. N88-23758
GEORGE, J. A. N88-24274
GEORGE, T. G. N88-24299
GEORGE, TIMOTHY G. N88-24428
GERARDI, L. H. O. N88-24064
GERNHARDT, M. L. N88-24146
GERRICK, R. A. N88-24415
GERVAISE, F. N88-24268
GETULIOMVIEIRA, ERNESTO N88-24086
GHANI, BAHARUDDIN ABDUL N88-23833
GILLIAN, RONNIE E. N88-23989
GILLIES, B. B. N88-24277
GILLIES, BRUCE B. N88-24411
GINGELL, DEAN N88-24204
GIORGI, N. N88-23771
GIRODROUX-LAVIGNE, P. N88-23949
GIUFFRIDA, MARIA R. N88-24128
GLADDEN, HERBERT J. N88-23957
GLASGOW, B. B. N88-24369
GLAZER, S. N88-23913
GLOVER, RICHARD D. N88-24206
GLUCK, R. N88-24285
GOILLAU, P. J. N88-24182
GOLDEN, D. M. N88-24012
GONCALVES, MARLEY N88-24032
GONCALVESDEARUJO, CARLOS ALBERTO N88-24061
GOODMAN, JULIUS N88-24337
N88-24473
GORDILLO, JOSE LUIS N88-23964
GORDON, STEPHEN S. N88-23980
GORTON, P. N88-23811
GRAHAM, LLOYD J. N88-23966
GRASSESCHI, GARY L. N88-24453
GRASSI, F. N88-24555
GRAVES, R. S. N88-24408
GRAY, K. E. N88-24535
GRAY, ORMAL E. N88-23941
GREENGARD, L. N88-24173
GREENSPAN, E. N88-24338
GREGG, HUGH N88-24190
GRIEST, KIM ELLWOOD N88-24568
GRIFFIN, CHARLES F. N88-23839
GRIFFIN, JOHN W. N88-23923
GRIMSHAW, ANDREW S. N88-24199
GRISVAL, J. P. N88-23952
GROEBNER, R. J. N88-24519
GROOTHUIZEN, R. J. P. N88-24171
GU, D.-W. N88-24210
N88-24211
GU, GUO-XIANG N88-24405
GU, GUOXIANG N88-24289
GU, PEI N88-23992
GUADAGNA, LISA M. N88-23785
GUERETTE, JACQUES N88-24034
GUERNY, GENE N88-24572
GURWELL, WILLIAM E. N88-24481
GYEKENYESI, JOHN P. N88-23875
GYGAX, F. N. N88-24245
N88-24246

H

HAALAND, RYAN K. N88-24444
HACK, EDMUND N88-24190
HAERTEL, VITOR N88-24027
HAGAN, J. C. N88-24361
HAINES, RICHARD F. N88-24149
HALFEN, F. J. N88-24306
N88-24356
HALL, MICHAEL L. N88-24347
N88-24399
HALL, S. R. N88-23819
HALL, WILLIAM N. N88-23812
HALLETT, MICHAEL DAVID N88-24159
HALOULAKOS, V. E. N88-24441
HAMADA, TADAAKI N88-24004
HAMEURLAIN, A. N88-24063
HAMEURLAIN, M. A. N88-24019
HAMMOND, J. K. N88-24237
HAMPSON, R. F. N88-24012
HANAN, N. A. N88-24263
N88-24304
HANAN, NELSON A. N88-24384
N88-24423
N88-24456
N88-24493
HANDELMAN, DAVE N88-23725
HANDSCHUH, ROBERT F. N88-23978
HANSEN, JAMES N88-24381
HANSMAN, R. JOHN, JR. N88-23717
N88-23718
HANSON, JACK N88-24460
HARDING, R. R. N88-24172
HARDY, TERRY L. N88-24296
HARPER, DOYAL A. N88-24550
HARRIES, WYNFORD L. N88-23971
HARRIS, C. D. N88-23741
HARRIS, J. M. N88-23916
HART, SANDRA N88-24151
HARTMAN, ROBERT F. N88-24403
HARTMANN, C. N88-24078
N88-24083
HARVEGO, E. A. N88-24277
HARVEY, W. DONALD N88-23741
HARYADI N88-23832
HASAN, MOHD A. N88-23930
HATTENBURG, ALBERT T. N88-23897
HAYES, STEVEN L. N88-24483
HAZARD, SHERRILL J., III N88-23944
HEALEY, KATHLEEN N88-24190
HEATH, D. MICHELE N88-23962
HEIBERGER, J. J. N88-24313
N88-24450
HEINBOCKEL, JOHN H. N88-23972
N88-24111
HENDERSON, DAVID E. N88-24163
HENDRICKS, ROBERT C. N88-23957
HENRY, ALLAN F. N88-24305
HENSLER, R. L. N88-24348
HERREN, G. N88-24020
N88-24066
HERTZBERG, A. N88-24367
HEWITT, DAVID N88-24023
HEYMAN, JOSEPH S. N88-23962
HEYMAN, JOSEPH SAUL N88-23963
HIDEKIYANASSE, HORACIO N88-24074
HIGGINS, J. A. N88-24539
HIGGINS, RAYMOND WAYNE N88-24119
HILL, ACQUILLA S. N88-23734
HILL, GREGORY N88-24314
HILL, K. N88-24514
HIRATA, M. N88-24530
HIRAYAMA, TOSHIO N88-24513
HITCHCOCK, JAMES N88-24343
HITTI, B. N88-24245
N88-24246
HITTI, B. S. N88-24247
HIXSON, JEFF N88-24202
HO, VINCENT N88-24364
HOFFMAN, DENNIS J. N88-24505
HOFFMAN, NATE N88-24273
HOFFMAN, NATHAN J. N88-24411
HOFFMANN, WILLIAM F. N88-24550
HOGBEN, ROGER ROY N88-23791
HOGE, F. E. N88-24108
HOLCOMB, R. S. N88-24349
HOLDEMAN, JAMES D. N88-23729
HOLMAN, R. R. N88-24297
HOLMAN, ROBERT R. N88-24471
HOLMES, BRUCE J. N88-23744
N88-23745
N88-23759
HOLMES, HARLAN K. N88-23743
N88-23759
HOLT, BENJAMIN N88-23932
HOLTZ, R. E. N88-24391
HOOD, VALERIE ANNE N88-24038
HOOKE, LYDIA RAZRAN N88-24155
HOOVER, MARK D. N88-24254
N88-24374
HOPPING, K. A. N88-24198
HORANYI, M. N88-24565
HORN, F. N88-24266
HORN, F. L. N88-24267
N88-24272
HORN, FREDERICK L. N88-24426
HORN, FREDRICK L. N88-24386
HORNSBY, JOHN K. N88-24037
HORWITZ, JAMES L. N88-24120
HOUSE, BRUCE L. N88-23803
HOWARD, C. J. N88-24012
HOWE, STEVEN D. N88-24380
HSUAN, H. N88-24514
HUANG, HSUEH-CHAO N88-23975
HUBLER, G. K. N88-23860
HUDSON, STEVEN L. N88-24385
HUEY, H. E. N88-24498
HUFFMAN, FRED N88-24310
HULL, DAVID R. N88-24491
HUMES, ROBERT L. N88-23717
HUNT, T. K. N88-24325
HUNT, THOMAS K. N88-24499
N88-24502
HURTAK, J. J. N88-24022
HURTAK, JAMES J. N88-24021
HURWITZ, FRANCES I. N88-23890
HUSSAINI, M. Y. N88-23943

HUTIN, P. M. N88-23951
HWANG, RICHARD H. N88-24264

I

IDA, KATSUMI N88-24529
IDE, ERIC N. N88-23940
IRELAND, P. T. N88-23950
IRWIN, J. J. N88-24284
ISENBERG, L. N88-24259
ISHANKULIEV, D. N88-24114
ISHANKULIEV, G. A. N88-24114
ISLER, R. N88-24525
ISOBE, TAKASHI N88-24551
ITIKAWA, YUKIKAZU N88-24532

J

JACKSON, DAVID R. N88-23929
JACOBS, A. M. N88-24290
JACOBSON, A. J. N88-24243
JACOBSON, N. S. N88-23885
JACOBUS, C. N88-24194
JACOX, MICHAEL G. N88-24378
N88-24414
N88-24435
JAHN, ROBERT G. N88-24294
JAMES, ARTHUR M. N88-23839
JANSSON, LARS N88-24103
JASKOWIAK, MARTHA H. N88-23891
JEANMOUGIN, NANETTE M. N88-24414
JEDRUCH, JACEK N88-24436
JEFFRIES-NAKAMURA, BARBARA N88-24501
JENKINS, JERALD M. N88-23999
JEWELL, N. T. N88-23773
JIMENEZ, RICHARD D. N88-24320
N88-24417
JOHNSON, BENJAMIN M. N88-24490
JOHNSON, CHARLES B. N88-23734
JOHNSON, ERIC R. N88-23840
JOHNSON, JOSEPH L., JR. N88-23746
JOHNSON, RICHARD A. N88-24422
JOHNSON, STEWART W. N88-24369
JOHNSON, THOMAS D., JR. N88-23760
JOHNSTON, D. C. N88-24243
JONES, B. I. N88-24351
JONES, JACK A. N88-23917
N88-23946
JONES, KENNIE H. N88-24185
JONES, R. L. N88-23864
JONES, T. V. N88-23950
JORDAN, FRANK L., JR. N88-23746
JOSEPH, P. N88-24237
JOSHI, AMIT S. N88-23727
JOSLIN, ARTHUR W. N88-24417
JOSLYN, H. D. N88-23956
JOYNER, W. T. N88-24316
JUBACH, R. W. N88-24362
JUHASZ, A. J. N88-24351
JUVE, DANIEL N88-24238

K

KABACOFF, LAWRENCE T. N88-23855
KACHNIK, LEO J. N88-24485
KAELLNE, E. N88-24517
KAHAN, W. N88-24175
KAISER, MARY KISTER N88-24152
KANEKO, H. N88-24523
N88-24524
KANGILASKI, M. N88-24265
KANIS, M. J. N88-24328
KANNE, WILLIAM R., JR. N88-24429
KARAS, LEONARD N88-23776
KATO, TAKAKO N88-24516
KEETON, ALVIN R. N88-24373
KEHELEY, EDWARD N88-24411
KEIRLE, P. N88-24475
KELLAWAY, W. E. R. N88-23798
KELLEY, HENRY L. N88-23809
KELLY, ARNOLD J. N88-24294
KELLY, C. E. N88-24300
KELLY, JOSEPH M. N88-24394
N88-24397
KEMPTON, J. R. N88-24244
N88-24245
N88-24246
N88-24247
KENDIG, M. N88-23865
KENNEL, E. B. N88-24257
KENNEY, JEFFREY DICKSON N88-24557
KENT, G. S. N88-24121
KESSAL, MOHAND N88-23948
KESSLER, W. C. N88-23823
KEY, J. R. N88-24123
KHANDELWAL, P. K. N88-23884
KHANNA, SATISH K. N88-24543
KHOE, G. H. N88-23867
KIDMAN, RUSSELL B. N88-24392
KIEFL, R. F. N88-24243
N88-24244
KIM, JONG SOO N88-24186
KIM, KILYOO N88-24364
KIM, THOMAS N88-24291
KING-HELE, D. G. N88-23818
KING, CHRISTOPHER ROGER N88-24558
KING, D. B. N88-24462
KINKEAD, REBECCA L. N88-23828
KIRBY, MARK S. N88-23717
N88-23718
KIRK, WILLIAM L. N88-24270
KIRTLEY, JAMES L., JR. N88-24340
KISER, JAMES D. N88-23985
KISSEL, RALPH R. N88-23959
KLEIN, ANDREW C. N88-24409
N88-24439
KLEIN, DANIEL B. N88-24341
KLEIN, GAIL N88-24273
KLETT, DAVID E. N88-24432
KNIGHT, NORMAN F., JR. N88-23989
KNIGHT, R. CRAIG N88-24478
KNOWLES, MARK N88-24229
KNOWLES, STEVEN C. N88-23830
KOBAYASHI, HEBERT N88-23923
KOESTER, J. KENT N88-24473
KOHN, S. N88-23935
KOHN, W. N88-24198
KOIDE, YOSHIHIKO N88-24513
KOJIMA, FUMIO N88-23918
KOLARIK, WILLIAM J. N88-24383
KONAGAYA, MASAAKI N88-24157
KONAGAYA, YOKO N88-24157
KONDO, K. N88-24523
KONDOH, T. N88-24530
KONG, H. S. N88-24317
KONOMOS, GEORGE N88-23789
KOSINSKI, F. E. N88-24283
KOSMAHL, HENRY G. N88-23936
KOSSLER, W. J. N88-24244
N88-24245
N88-24246
N88-24247
KOTSIS, APOSTOLOS N88-24115
KRAMER, EDWARD H. N88-23829
KREITZMAN, S. R. N88-24243
N88-24244
KRISCH, JEAN P. N88-24546
KRISHNAIAH, P. R. N88-24228
KROHN, JOHN L. N88-24368
KROTIUK, WILLIAM J. N88-24439
N88-24466
KRUG, THELMA N88-24045
N88-24084
N88-24093
KUBO, HIROTAKA N88-24513
KUKACKA, L. E. N88-23849
KULCINSKI, G. L. N88-24330
N88-24366
N88-24474
KULCINSKI, GERALD L. N88-24390
KULWICKI, PHILIP V. N88-23785
KUMAR, A. N88-24370
KUMAR, AJAY N88-23735
KUMAR, SUNIL N88-24226
KUNZE, JAY F. N88-24289
N88-24405
KURIANSKI, JERZY MIECZYSLAW N88-24510
KURINO, SAYA N88-24011
KURINO, TOSHIYUKI N88-24006
N88-24007
KURYLO, M. J. N88-24012
KUSHNER, L. N88-23919
KUX, HERMANN J. H. N88-24092
KWOK, KWAN S. N88-24305
N88-24494

L

LABORDE, R. N88-24339
LACEY, P. D. N88-24402
LACEY, P. DOUGLAS N88-24469
LACEY, W. GREG N88-24392
LAKE, J. A. N88-24345
LAMAR, JOHN E. N88-23760
LAMB, JAMES L. N88-24543
LAMB, MILTON N88-23757
LAMONICA, FRANK S. N88-23800
LAMPARELLI, R. A. C. N88-24078
LANCE, JOSEPH R. N88-24471
LANDERS, THOMAS L. N88-24383
LANDGREBE, ALBERT R. N88-23861
LANKFORD, W. F. N88-24247
LANNING, DAVID D. N88-24305
LAPIN, SAMANTHA N. N88-24354
LAROCHE-LEVY, P. N88-23799
LAROCHE-LEVY, PHILIPPE N88-23802
LARSON, T. K. N88-24365
LASECKI, J. V. N88-24325
LATHAM, L. B. N88-24440
LAURIENTE, MICHAEL N88-23812
LAVERTY, IAN N88-24018
LAWANDY, NABIL M. N88-23841
LAWRENCE, CHARLES N88-23994
LAZARETH, O. N88-24272
LAZARETH, OTTO W. N88-24426
LE, ANH H. N88-23855
LEAR, W. E., JR. N88-24290
LEAR, WILLIAM E., JR. N88-24472
LEBALLEUR, J. C. N88-23949
LECLAIRE, RENE J., JR. N88-24380
LEE, DAVID CHUNG LIANG N88-24016
N88-24073
LEE, DOOJEONG N88-24467
LEE, JAMES N88-24363
LEE, MARK C. N88-23895
N88-23911
LEE, SHENG Y. N88-23894
LEHOCZKY, S. L. N88-23893
N88-23898
LEHOCZKY, SANDOR L. N88-24544
N88-24545
LEIDHEISER, HENRY, JR. N88-23859
LEIGHTY, BRADLEY D. N88-23942
LELL, R. M. N88-24263
N88-24304
LEMMON, J. N88-24554
LEONARD, RAYMOND S. N88-24389
LEPICOVSKY, J. N88-23751
N88-23752
N88-23753
LESNIEWSKI, C. N88-23870
LEVINE, STANLEY R. N88-23873
LEVY, MILTON N88-23850
LEW, BARCLAY S. N88-24424
LEWANDOWSKI, J. T. N88-24243
LEWIS, JAMES K. N88-24128
N88-24129
LIANG, E. P. N88-24570
LIEBMAN, A. N88-23831
LILLEY, ROBERT W. N88-23720
LIMADALGE, JULIO CESAR N88-24061
LIN, EUGENE YUH-JI N88-23976
LINDBERG, L. J. N88-23886
LINDNER, DOUGLAS K. N88-23940
LING, JERRI S. N88-23829
LIPINSKI, WALTER C. N88-24423
N88-24493
LIRA, J. N88-24025
LITT, MORTON H. N88-23889
LITZ, BRADLEY C. N88-24401
LIU, HUA-KUANG N88-24508
LIU, JANE W. S. N88-24199
LOCKE, C. DOUGLASS N88-23778
LOESER, H. N88-24131
N88-24132
N88-24133
N88-24134
LOETZERICH, K. N88-24134
LOEVE, W. N88-24178
LOMBARDO, JAMES J. N88-24361
N88-24400
LONG, STUART A. N88-23929
LONGDON, NORMAN N88-23814
LOPEZ-VALDIVIA, SALVADOR N88-24125
LORK, F. J. N88-23770
LOTTES, P. A. N88-24391
LOUIS, JEAN F. N88-24471
LOVELAND, M. E. N88-24324
LUDEWIG, H. N88-24267
N88-24272
N88-24275
LUDEWIG, HANS N88-24426
LUKER, S. M. N88-24309
N88-24462
LUMB, D. H. N88-24554
LUMSDEN, J. B. N88-23853
LUNDBERG, LYNN B. N88-24333
LUNDIN, ROBERT S. N88-24479
LYNDON, C. N88-24248
LYON, WILLIAM F., III N88-24288

M

MACCONOCHIE, IAN O. N88-23828

MACDONALD, R. N88-24180
MADDALON, DAL V. N88-23748
MADDING, R. N88-23913
MADSON, MICHAEL D. N88-23750
MAHAFFEY, MICHAEL K. N88-24375
MAHEFKEY, TOM N88-24470
MAJUMDAR, S. N88-24313
MALBEQUI, P. N88-24235
MALLEY, H. M. N88-23773
MANGELS, J. A. N88-23879
MANKBADI, REDA R. N88-23732
MANKINS, J. N88-24259
MANKINS, JOHN CARLTON N88-24376
MANSFIELD, F. N88-23865
MANZO, G. N88-24554
MARELLI, LIVIO N88-24040
MARHEFKA, R. J. N88-23931
MARKLEY, F. LANDIS N88-24165
MARKLEY, ROBERT A. N88-24420
N88-24499
MARR, DUANE R. N88-24392
MARSHALL, ALBERT C. N88-24355
MARTIN, ANDREW N88-24444
MARTIN, GLEN L. N88-23745
MARTINI, K. F. N88-24233
MARTINKO, EDWARD A. N88-24101
MARTINSON, ZOEL R. N88-24482
MARTS, D. J. N88-24287
MARTY, PH. N88-24339
MASCARENHAS, NELSON D. A. N88-24056
N88-24062
MASLANIK, J. A. N88-24123
MASSAMBANI, OSWALDO N88-24057
MASSIE, LOWELL D. N88-24505
MASTERS, RICHARD N88-24503
MATTHEWS, R. BRUCE N88-24327
N88-24485
MAURICIO, JOSE ANTONIO N88-24084
MAX, STEPHEN R. N88-24157
MAYA, ISAAC N88-24291
N88-24337
MAYA, ISSAC N88-24473
MAYNARD, C. W. N88-24366
MCBRIDE, J. R. N88-24325
MCBRIDE, JAMES R. N88-24502
MCCABE, S. J. N88-24323
MCCAFFERTY, E. N88-23860
MCCANDLESS, S. W. N88-24260
MCCORD, THOMAS B. N88-24564
MCCULLOCH, WILLIAM H. N88-24504
MCDANIEL, JOE W. N88-23785
MCDANIEL, PATRICK N88-24363
MCDONOUGH, J. N88-23935
MCELROY, D. L. N88-24281
N88-24408
MCFARLAND, RICHARD H. N88-23719
MCFARLANE, H. F. N88-24286
MCGHEE, JOHN M. N88-24492
MCGHEE, R. J. N88-23741
MCGRAW, K. N88-24259
MCGREW, JOHN W. N88-24301
MCINNIS, B. C. N88-24213
MCKEE, BOBBY D. N88-24433
MCKENZIE, D. K. N88-24158
MCKNIGHT, RICHARD D. N88-24293
MCKNIGHT, ROBERT C. N88-23717
MCLYMAN, W. T. N88-23937
MCNALLY, B. DAVID N88-23762
MCNICHOLS, J. L. N88-24415
MCROY, C. PETER N88-24126
MCSMITH, DWIGHT D. N88-23982
MCVEY, J. B. N88-24311
N88-24498
MEIER, G. E. A. N88-23947
MEISNER, JOHN W. N88-24430
MELLANO, W. N88-23771
MENADIER, PAUL T. N88-24494
MENDES, CELSO LUIS N88-24065
MENDONCA, FRANCISCO JOSE N88-24046
MENESES, PAULO ROBERTO N88-24082
MENU, J. P. N88-23784
MERCHANT, JAMES W. N88-24101
MERIENNE, M. C. N88-23835
MERKINA, K. I. N88-24114
MERRIGAN, MICHAEL A. N88-24345
N88-24346
N88-24396
N88-24419
MERTE, HERMAN, JR. N88-24464
METCALF, KENNETH J. N88-24430
METERSKY, M. L. N88-23782
METZGER, JOHN D. N88-24307
N88-24380
MEYER, FRED H., JR. N88-23847
N88-23863
MEYER, JOHN E. N88-24305
MEYER, R. A. N88-24306
N88-24356
MICHENER, THOMAS E. N88-24465
MIKULAS, MARTIN M., JR. N88-23828
MILLER, A. D. N88-23887
MILLER, B. P. N88-24260
MILLER, ROBERT N. N88-23963
MILLER, W. C. N88-24284
N88-24285
MILLER, WILLIAM C. N88-24375
MILLER, WILLIAM E. N88-23962
MILLER, WILSON N. N88-23941
MILLIERE, C. N88-23836
MILLION, BENEDICTE N88-24250
MIMS, JAMES N88-24331
MIMS, JIM N88-24492
MIMURA, MIKIO N88-24533
MIRANDA, HENRY A., JR. N88-23905
MITCHELL, B. N88-24194
MIYAJI, SHIGEKI N88-24562
MIYOSHI, S. N88-24530
MIZUUCHI, T. N88-24523
MODESTODESOUZA, RICARDO CARTAXO N88-24065
MOE, KAREN N88-24572
MOELLER, O. O., JR. N88-24083
MOHTADI, C. N88-24209
MOLINA, M. J. N88-24012
MOLINAMARINO, LUIS CARLOS N88-24036
MONDT, J. N88-24259
MONTAGUE, ALLEN F. N88-24345
MONTGOMERY, R. O. N88-24288
MOODENBAUGH, A. R. N88-24243
MOORE, R. K. N88-23927
MOORE, ROGER M. N88-24414
MOORE, T. J. N88-24279
MOORE, THOMAS C. N88-23759
MOORE, THOMAS J. N88-24491
MOOS, WARREN N88-24521
MORAIN, STANLEY A. N88-24387
MOREIRA, JOSE CARLOS N88-24067
MOREY, DENNIS C. N88-24409
MORGAN, HARRY L. N88-23739
MORGAN, KEN N88-24001
MORITA, SHIGERU N88-24515
MORPHET, FRANK N. N88-23791
MORRELL, FREDERICK R. N88-23715
MORRIS, D. G. N88-24312
MORRIS, DAVID G. N88-24431
MORRIS, P. J. N88-23751
N88-23752
N88-23753
MORRIS, SHELBY J., JR. N88-23806
MORROW, PAUL N88-24196
MOSES, DAVID L. N88-24293
MOSS, RONALD W. N88-24481
MOSSER, MARK F. N88-23858
MOSTAFA, S. I. N88-23945
MOUROU, G. N88-24507
MOWERY, A. L., JR. N88-24361
MOYERS, J. C. N88-24349
MUELLER, J. I. N88-23878
MUENIER, M. N88-23794
MUNZ, P. D. N88-23945
MURPHY, K. A. N88-24164
MURRAY, KATHY N88-24273
MURRI, DANIEL G. N88-23754
MUSICKI, Z. N88-24474
MUSIELAK, Z. E. N88-24561
MUSIKANT, SOLOMON N88-24459
MYERS, IRA T. N88-24388

N

NAGESH, V. N88-24317
NAGLE-ESHLEMAN, JUDITH N88-24214
NAKAMURA, B. J. N88-24324
NAKAMURA, YUKITAKA N88-24053
NATISHAN, P. M. N88-23860
NAUMANN, ROBERT J. N88-24544
N88-24545
NECIB, BRAHIM N88-23995
NELSON, P. A. N88-24237
NEMETH, MICHAEL P. N88-23989
NETO, GILBERTO CAMARA N88-24065
N88-24080
NEUBAUER, F. M. N88-24232
NGUYEN, T. N88-23934
NICHOLS, J. P. N88-24349
NICKEL, HUBERTUS N88-23990
NICOL, DAVID M. N88-24203
NIEH, T. G. N88-24278
NING, CARLOS HO SHIH N88-24053
N88-24059
NISHIMURA, S. N88-24523
NONAMI, KENZOU N88-23977
NORDINE, PAUL C. N88-23906
NOTTON, M. N88-23866
NOVACKI, STANLEY M., III N88-23721
NOVAES, RENE ANTONIO N88-24016
NOVAK, R. F. N88-24325
NOVAK, ROBERT F. N88-24502
NOVELLI, YARA SCHAEFFER N88-24086
NOVO, EVLYN M. LEAO N88-24075
NUTTER, G. D. N88-23898

O

OAKES, LESTER C. N88-24480
OBARA, CLIFFORD J. N88-23742
N88-23745
OBERLY, CHARLES E. N88-24505
OCHI, SIMEON C. U. N88-23987
ODA, T. N88-24523
OESBERG, ROLF-PETER N88-24035
OHAYON, R N88-24220
OKADA, H. N88-24523
OKAIN, D. U. N88-24349
OKAZAKI, K. N88-24523
OKRENT, DAVID N88-24424
OLIVER, C. C. N88-24290
OLIVER, CHARLES E. N88-23959
OLIVER, DOUGLAS L. R. N88-24334
OLIVIERI, J. N88-24259
OLIVIERI, JERRY N88-24376
OLSEN, D. N. N88-24286
OLSEN, DAVID N. N88-24453
OLSEN, SCOTT N88-24499
OLSON, ARNE P. N88-24457
OLSZEWSKI, M. N88-24312
OLSZEWSKI, MITCHELL N88-24431
N88-24432
ONIGATA, TOSHIO N88-24008
OOSAWA, KAZUHIRO N88-24005
OPIE, D. N88-24244
ORTH, CHARLES D. N88-24273
OSGOOD, RICHARD M., JR. N88-23920
N88-23921
OSHER, STANLEY N88-24217
OTSUKA, MASAMOTO N88-24533
OZAKI, T. N88-24518

P

PACHECODOSSANTOS, ARMANDO N88-24016
PACIEJ, RICHARD C. N88-23852
PADDACK, STEVEN N88-24572
PAFFORD, DANIEL J. N88-24335
PAGE, JOHN P. N88-24484
PAK, EN MEN N88-24536
PARKS, D. L. N88-24277
PARKS, ROGER E. N88-23780
PARLOS, ALEXANDER G. N88-24492
N88-24495
PARRAG, MIKE N88-23797
PASCAUD, P. N. N88-24017
PATEL, MIKUND R. N88-23939
PATEL, VIPUL N88-24032
PATTERSON, MICHAEL J. N88-24295
N88-24296
PATTILLO, STEVAN G. N88-24371
PAWEL, R. E. N88-24281
N88-24408
PAZ, R. S. N88-24083
PEACOCK, A. N88-24554
PEARSON, RICHARD J. N88-24421
PEDDICORD, K. L. N88-24274
N88-24288
N88-24298
N88-24329
PEDDICORD, K. LEE N88-24483
PEDDICORD, KENNETH L. N88-24404
N88-24438
PEELING, S. M. N88-23927
PEISEN, DEBORAH N88-23810
PELIN, ALEX N88-24196
PELLONDEMIRANDA, FERNANDO N88-24099
PENDLETON, YVONNE JEAN N88-24559
PENNINGTON, JACK E. N88-23828
PERDRISAT, C. F. N88-24248
PEREIRA, M. C. N88-24085
PEREIRADACUNHA, ROBERTO N88-24015
N88-24043
N88-24044
PEREPEZKO, J. H. N88-23899
PERKINS, DAVID R. N88-24271
PERRY, BOYD, III N88-23807
PERRY, G. L. E. N88-23893
PERRY, JIMMY L. N88-24168
PETRASEK, D. W. N88-24427

PETRICK, S. WALTER N88-23946
PETZINGER, K. G. N88-24247
PFAFFELHUBER, MATTHIAS N88-23990
PFEFFERMANN, E. N88-24554
PFENNIGER, DANIEL N88-24556
PHILLIPS, KEITH L. N88-24497
PHILLIPS, ROBERT K. N88-23997
PICHI, F. J. N88-24172
PIERCE, BILL L. N88-24420
PILE, P. N88-24248
PILGER, JAMES P. N88-24481
PINTO, SERGIO DOSANJOS F. N88-24075
PINTODEGARRIDO, JUAN CARLOS N88-24065
POCIUS, A. V. N88-23862
POE, C. C., JR. N88-23638
PONZONI, FLAVIO JORGE N88-24016
N88-24073
PORTAL, MARC-EMMANUEL G. N88-24404
POSTLETHWAITE, I. N88-24210
N88-24211
POWELL, J. R. N88-24272
N88-24275
POWELL, JAMES R. N88-24426
PRATER, JOHN T. N88-24448
PRELAS, MARK A. N88-24289
N88-24405
PRESSENTIN, R. N88-24367
PRESTON, J. LAWRENCE, JR. N88-24451
PRICE, DOUGLAS B. N88-23768
PRICE, J. C. N88-24108
PRIEST, V. N88-24319
PROTSIK, R. N88-24265
PROTZEL, PETER W. N88-23984
PROUST, E. N88-24268
N88-24475
PROVESI, JOSE ROBERTO N88-24093
PRUVOST, J. N88-23730
PSHENICHNY, V. A. N88-24536
PTAK, ROGER L. N88-24552
PUNJABI, V. N88-24248

R

RAAG, VALVO N88-24503
RADFORD, C. J. N88-24181
RAED, M. A. N88-24020
N88-24066
RAGHU, SURYA N88-23843
RAMAN, GANESH N88-23732
RAMSTHALER, J. H. N88-24277
RAMSTHALER, JACK H. N88-24379
N88-24482
RANDALL, DONALD P. N88-24185
RANKEN, W. A. N88-24280
RANSOM, V. H. N88-24365
RANSOM, VICTOR H. N88-24344
RASCHKE, E. N88-24232
RASHKOW, BRUCE C. N88-24410
N88-24411
RASMUSSEN, JAMES R. N88-24499
RASOR, N. S. N88-24311
RAVAT, C. J. C. N88-23770
RAVISHANKARA, A. R. N88-24012
RAWLIN, VINCENT K. N88-24295
N88-24296
RAY, JOHN R. N88-24546
RAYALU, G. K. N88-24029
RAYMOND, F. N88-23934
RAYMOND, LOUIS N88-23848
REASONER, DAVID L. N88-24253
REBILLARD, PH. N88-24017
REDMON, JOHN W., SR. N88-23959
REED, T. R. N88-24287
REED, W. C. N88-24277
REICH, MANFRED N88-23926
REICHEL, D. G. N88-24319
REID, ROBERT N88-24345
REID, ROBERT S. N88-24419
REILLY, J. J. N88-24247
REMINGTON, ROGER N88-24152
RENKEY, E. J. N88-24284
RENNEISEN, JOHN D. N88-23986
REYNOLDS, JOHN M. N88-24253
RHEE, HYOP S. N88-24473
RHODES, DONNA N88-23776
RHODES, PERCY H. N88-23845
RIBEIRODOSSANTOS, ATHOS N88-24050
RIBOT, HERVE N88-23969
RICE, EDWARD J. N88-23732
RICHARDSON, ANNIE N88-23932
RICHARDSON, JERRY K. N88-24184
RICHARDSON, KEITH N88-24192
RICHMOND, MARSHALL CHARLES N88-23954
RIECKHOFF, TOM N88-24202
RINSLAND, C. P. N88-24541
N88-24542
ROBBINS, J. M. N88-24281
ROBERTODOSSANTOS, JOAO N88-24087
ROCH, JEAN LOUIS N88-23786
ROCHE, GREGORY L. N88-24342
RODERJAN, CARLOS VELLOZO N88-24091
RODRIGUES, JOSE EDUARDO N88-24099
RODRIGUEZ, O. N88-23730
ROE, FRED D., JR. N88-24163
ROEDIG, MANFRED N88-23990
ROKHLIN, V. N88-24173
ROLAND, PIERRE N88-24238
RONNEY, PAUL D. N88-23903
ROSA, R. N88-24070
N88-24078
ROSA, ROBERTO N88-24075
ROSACARNEIRO, PAULO JORGE N88-24048
ROSENTHAL, DANIEL ALFREDO N88-24047
ROSNER, R. N88-24561
ROSOT, NELSON CARLOS N88-24087
ROSS, F. K. N88-24319
ROSS, J. R. N88-24286
ROSS, STEVEN B. N88-24327
N88-24485
ROTH, PAUL A. N88-24357
ROVIRA, M. N88-24560
ROWE, D. M. N88-24538
ROWE, JOSEPH N88-24155
ROWELL, LAWRENCE F. N88-24185
ROWLAND, M. E. N88-23781
ROYER, L. T. N88-24283
ROYER, M. N88-23934
RUBINCAM, DAVID P. N88-24118
RUDOKAS, MARY R. N88-24189
RUDORFF, BERNARDO F. T. N88-24045
RUGGLES, JOHN F. N88-24302
RUSHTON, B. L. N88-24348
RUSSELL, RICHARD A. N88-23824
N88-23826
RYDER, J. L. N88-23782

S

SACKSTEDER, KURT N88-23902
SAGER, WILLIAM W. N88-24118
SAHINES, T. P. N88-24311
N88-24498
SAILEY, RICHARD H. N88-23755
SAKASAI, AKIRA N88-24513
SALIKUDDIN, M. N88-23751
N88-23752
N88-23753
SALMON, J. A. N88-23770
SALZMAN, JACK N88-23901
SAMSON, JAMES A. R. N88-24252
SAMUELS, JEFFERY W. N88-24486
SANDER, S. P. N88-24012
SANDERS, FRED G. N88-23979
SANDERS, WILLIAM A. N88-23882
SANDFORD, MAYNARD C. N88-23756
N88-23807
SANO, E. E. N88-24070
N88-24078
N88-24083
SANTARIUS, J. F. N88-24330
N88-24366
N88-24474
SANTIADOBARROS, MARIA SUELENA N88-24074
SANTOS, AUXILIADORA MARIA N88-24086
SARAIVA, ILIANA RAJO N88-24094
SARMA, S. V. KAMESWARA N88-24030
SARPKAYA, T. N88-23945
SASAO, M. N88-24527
SATO, KUNINORI N88-24520
N88-24533
SAUSEN, TANIA MARIA N88-24069
N88-24076
N88-24077
SAWAN, M. E. N88-24366
N88-24474
SCAMMAN, J. F. N88-24318
SCHATTEN, KENNETH H. N88-24118
SCHEMBER, HELENE N88-23917
SCHENCK, A. N88-24245
N88-24246
SCHEUERMANN, C. M. N88-24279
SCHEUERMANN, COULSON M. N88-24491
SCHIFFMAN, ROBERT A. N88-23906
SCHIRLE, PATRICK N88-23777
SCHMID, ANSGAR N88-24537
SCHMIDT, J. E. N88-24458
SCHMIDT, J. ED N88-24420
SCHMIDT, J. EDWARD N88-24499
SCHMIDT, M. A. N88-24328
SCHMIDT, R. E. N88-24315
SCHNITZLER, B. G. N88-24348
SCHNITZLER, BRUCE G. N88-24442
SCHOCK, A. N88-24361
SCHOENLEIN, LARRY H. N88-24478
SCHONE, H. E. N88-24244
N88-24245
N88-24246
N88-24247
SCHUBERT, FLORIAN N88-23990
SCHWARTZ, J. P. N88-24268
SCHWARZE, GENE E. N88-24483
N88-24506
SCHWEER, B. N88-24528
SCHWEIGER, L. J. N88-24285
SEDENO, A. N88-24079
SEIDEL, DAVID A. N88-23756
SEIFERT, DAVID A. N88-24481
SELEROWICZ, W. C. N88-23947
SENNETT, C. T. N88-24179
N88-24180
SENTIS, M. N88-23970
SEO, JONG T. N88-24354
N88-24358
N88-24372
N88-24398
N88-24406
SERAFINI, MARIA C. N88-24041
SERAYDARIAN, R. P. N88-24519
SERIES, R. W. N88-24181
SETZER, A. W. N88-24085
SETZER, ALBERTO W. N88-24056
N88-24086
SEYMOUR, E. F. W. N88-24247
SHAH, M. N88-24321
SHAH, S. L. N88-24209
SHANKAR, VIJAYA N88-23736
SHANNON, JOHN L., JR. N88-23877
SHEN, E. J. N88-24284
N88-24285
SHEPARD, J. N88-23772
SHEPARD, ROBERT L. N88-24480
SHERRY, CHOU CHEN N88-24096
SHERWOOD, BRENT N88-23825
SHIEH, L. S. N88-24213
SHIELDS, NICHOLAS L. N88-24163
SHIMABUKURO, YOSIO E. N88-24027
SHOLTIS, JOSEPH A., JR. N88-24410
SHORE, CHARLES P. N88-23817
SHORE, STEVEN N. N88-24563
SHORES, PAUL W. N88-23923
SHORT, BARRY J. N88-24487
SHU, CHI-WANG N88-24217
SIEGMUND, DAVID N88-24229
SIEVERS, ROBERT K. N88-24499
SIGETY, P. N88-23837
SILVA, DAGOBERTO N88-24092
SILVEIRAESPINDOLA, CARMEN REGINA N88-24072
SILVERMAN, SIDNEY W. N88-24314
SIMAN-TOV, MOSHE N88-24432
SIMONEAU, ROBERT J. N88-23957
SIMONI, PAULO OUVERA N88-24026
N88-24068
SIMONS, PHILIP H. N88-23783
SIMPSON, R. J. N88-24142
SIMPSON, ROBERT W. N88-23716
SJOELAND, BARBRO N88-24176
SJOELAND, MAGNUS N88-24176
N88-24177
SKRABEK, E. A. N88-24301
N88-24361
SLABY, JACK G. N88-24255
SLATER, P. N. N88-24108
SLISSA, MONIQUE N88-23802
SLOVIK, G. N88-24267
N88-24272
N88-24275
SMALLEY, LARRY L. N88-24546
N88-24547
SMIALEK, J. L. N88-23885
SMILDE, P. L. N88-24117
SMITH, DALE M. N88-24453
SMITH, DAVID N88-24224
SMITH, EARNEST C. N88-23959
SMITH, M. A. H. N88-24541
N88-24542
SMITH, R. A. C. N88-23773
SMOLIK, G. R. N88-24287
SMYRL, WILLIAM H. N88-23861
SNYDER, ROBERT S. N88-23845
N88-23904
SOBIESZCZANSKI-SOBIESKI, JAROSLAW N88-23766
SODERMAN, PAUL T. N88-24239
SOFFEN, GERALD N88-24572
SOLEWICZ, REINALDO N88-24024
SOLLO, CHARLES N88-24434
SOLON, M. N88-24272
SOOSAAR, K. N88-23823

SORENSEN, G. L. N88-24402
SORENSEN, GEORGE N88-24303
SOUZASAMPAIO, OSVALDO N88-24052
SPENCER, MARK N. N88-23905
SPERO, E. N88-24338
SPETH, P. N88-24232
SPIRIO, CARMELO A. N88-24452
SPJUT, R. ERIK N88-23907
SRINIVASAN, MAHESH N88-24174
STARNES, JAMES H., JR. N88-23840
STEIN, ALEXANDER N88-23910
STELLBRINK, K. N88-23837
STENGEL, ROBERT F. N88-23724
N88-23726
STEPHENS, J. J. N88-24278
STEVENSON, MERRITT R. N88-24024
N88-24058
STOKES, A. WESTAGARD N88-24233
STONE, JAMES R. N88-24443
STONE, NOBIE H. N88-24253
STONER, RONALD E. N88-24552
STORHOK, V. W. N88-24348
STRACK, WILLIAM C. N88-23806
STROEMBERG, DAN N88-24208
STRONACH, C. E. N88-24244
N88-24245
N88-24246
N88-24247
STUBBINS, WARREN FENTON N88-24292
STUDER, PHILIP A. N88-23808
STUMP, KEAN G. N88-24439
STUPIN, DAVID M. N88-24371
SU, CHING-HUA N88-23893
SUE, MILES N88-23933
SUENAGA, M. N88-24243
SUERY, M. N88-23836
SUGAI, MASAAKI N88-24008
SUGAMA, TOSHIFUMI N88-23849
SUGG, FRANK E. N88-23966
SUGIE, TATSUO N88-24513
SUIT, WILLIAM T. N88-23768
SUKORIANSKY, S. N88-24338
SULLIVAN, WALTER N88-24572
SULMEISTERS, TAL K. N88-24379
SUNDBERG, GALE R. N88-24256
SUNDERLAND, DION J. N88-24298
SUNDQUIST, B. E. N88-24326
SUNG, JEN-CHUN N88-23996
SUTTER, R. N88-24248
SUVIRES, GRACIELA M. N88-24088
N88-24089
N88-24098
SUZUKI, KAZUFUMI N88-24010
SVANTESSON, MATTI N88-24102
SVIATOSLAVSKY, I. N. N88-24366
N88-24474
SWALLOM, DANIEL W. N88-24336
SWANSON, CHARLES P. N88-23959
SWINNEY, KENNETH R. N88-24120
SZEMA, KUO-YEN N88-23736
SZOFRAN, F. R. N88-23893
N88-23898
SZUMOWSKI, A. P. N88-23947
SZYMANSKI, BOLESLAW N88-24174

T

TAKACS, L. N88-23931
TAKEIRI, Y. N88-24523
TAKEUCHI, HIROSHI N88-24513
TAKEUCHI, YOSHIAKI N88-24005
N88-24009
TAKIYAMA, KEN N88-24526
TANAKA, KEIKO N88-24053
N88-24054
TANG, C. F. N88-24370
TANKESLEY, EARSA L. N88-23749
TANNER, TRIEVE N88-24148
TAPPE, W. N88-24272
TATE, R. E. N88-24299
TAVARESDEMATTOS, JUERCIO N88-24052
TAYLOR, ALLAN H. N88-23981
TAYLOR, JOHN N88-24023
N88-24032
TEETER, RONALD N88-24155
TEIXEIRA, A. L. A. N88-24064
THAKOOR, ANILKUMAR P. N88-24543
THAKOOR, SARITA N88-24543
THART, W. G. J. N88-23837
THIBAULT, J. P. N88-24339
THOMAS, J. K. N88-24288
N88-24329
THOMAS, J. KELLY N88-24483
THOMAS, JAMES K. N88-24438
THOMAS, M. N88-23811
THOMAS, ROBERT J., JR. N88-23721
THOME, FRANK V. N88-24494
THOMPSON, JACK N88-23810
THOMPSON, JAMES J. N88-23852
THORNTON, EARL A. N88-24001
TILLIETTE, Z. N88-24268
N88-24475
TILTON, DONALD E. N88-24470
TITRAN, R. H. N88-24427
TOWER, LEONARD K. N88-24395
TOWNSEND, JOHN S. N88-23988
TOWNSEND, L. W. N88-24251
TOWNSEND, LAWRENCE W. N88-24571
TRETYAKOVA, S. P. N88-24114
TRIUMPH, THERESE F. N88-24446
TROCCIOLA, JOHN C. N88-24451
TROEGER, R. E. N88-24321
TROUVE, J. N88-24475
TRUEBLOOD, B. N88-24367
TSAI, M. C. N88-24210
N88-24211
TSAO, SYLVIA S. N88-24461
TSOUPAS, N. N88-24248
TUCKER, MICHAEL ROBERT N88-24212
TUNG, VU X. N88-24393
TURNER, J. D. N88-23823
TUTTLE, RONALD F. N88-24437

U

UCHIYAMA, AKIHIRO N88-24006
UDRY, STEPHANE N88-24556
UEMURA, Y. J. N88-24243
N88-24244
N88-24245
N88-24246
UHERKA, K. L. N88-24391
ULMSCHNEIDER, P. N88-24561
UNDERWOOD, MARK L. N88-24501

V

VAIDYANATHAN, S. N88-24265
VALENTE, A. N88-23771
VALENTEKOVICH, VLADIMIR N88-24335
VALENTEKOVICH, VLADIMIR M. N88-24468
VALERIANO, DALTON DEM. N88-24086
VALERIANO, DALTON DEMORISSON N88-24093
VAMPOLA, ALFRED L. N88-23812
VANALSTINE, J. M. N88-23916
VANBIBBER, LAWRENCE E. N88-24471
VANDAM, CORNELIS P. N88-23747
VANDENBERG, J. I. N88-24171
VANDENBERG, JAN N88-24236
VANDERBORGH, NICHOLAS E. N88-24452
VANDERENT, E. J. N88-24106
N88-24107
VANDERSANDE, JAN W. N88-24503
VANDERZIJP, J. N88-24195
VANDRIEL, N. N88-23801
VANGRAAS, FRANK N88-23722
VANHORSSEN, W. T. N88-23991
VANLEEUWEN, W. N88-24171
VANOVERBEKE, THOMAS J. N88-23729
VANZETTI, RICCARDO N88-23909
VARY, ALEX N88-23876
VASANTH, K. L. N88-23854
N88-23857
VAUGHAN, F. R. N88-24362
VECA, A. R. N88-24280
VENEZIANI, PAULO N88-24052
VEREEN, MARY N88-24188
VERHEIJ, L. F. N88-24104
VERTEBNYJ, V. P. N88-24536
VETTORAZZI, CARLOS A. N88-24042
VIJAYKUMAR, NANDAMUDI LANKALAPALLI
N88-24074
VIKEN, JEFFREY K. N88-23738
VILJA, J. O. N88-23831
VLASSE, MARCUS N88-24545
VOGELSANG, W. F. N88-24366
N88-24474
VONFLOTOW, A. H. N88-23819
VONGOELER, S. N88-24514
VOROBKALO, F. M. N88-24536
VRILLON, B. N88-24268
N88-24475
VYKUKAL, H. C. N88-24145

W

WADKINS, R. P. N88-24348
WADSWORTH, J. N88-24278
WAGGONER, EDGAR G. N88-23740
WAGNER, R. G. N88-24535
WAGNER, RICHARD D. N88-23748
WAGONER, W. R. N88-23781
WAIT, D. L. N88-24382
WAIT, DAVID L. N88-24414
WAITE, J. H., JR. N88-24565
N88-24566
WALKER, DOREEN M. C. N88-23818
WALKER, GILBERT H. N88-24111
WALKER, JAMES H. N88-23897
WALKER, V. A. N88-24348
WALLACE, CHARLES C. N88-23959
WALLACE, DEAN N88-23792
WALLIS, GENE N88-24439
WALSTROM, P. L. N88-24474
WALTER, CARL E. N88-24350
WALTON, JAMES T. N88-23805
WANG, CAROLINE N88-24201
WANG, J. C. N88-24213
WANG, P. H. N88-24121
WARGO, MICHAEL J. N88-23914
WASHBURN, LIBE N88-24122
WATERS, WILLIAM R. N88-23897
WATSON, ANDREW B. N88-24150
WEBB, BRENT J. N88-24439
WEBB, D. D. N88-24113
WEBER, NEILL N88-24499
WEBER, RUDOLF E. N88-24549
WELCH, CHRISTOPHER N88-23962
WELCH, GERARD E. N88-24472
WERKOFF, F. N88-24339
WERNER, JENNIFER S. N88-23905
WERTHEIM, RONALD J. N88-24451
WESSELSKI, CLARENCE J. N88-23827
WETCH, J. R. N88-24257
WETCH, JOSEPH R. N88-24473
WETT, J. F. N88-24458
WHALEN, THOMAS J. N88-23879
WHEELER, B. L. N88-24324
WHEELER, D. R. N88-24279
WHEELER, F. J. N88-24348
WHEELIS, W. T. N88-24309
N88-24462
WHITBECK, J. F. N88-24277
WHITCOMB, JOHN D. N88-23998
WHITE, A. M. N88-23938
WHITE, GEORGE D. N88-24481
WHITE, JACK L. N88-23868
WIESE, W. L. N88-24512
N88-24534
WIESEMAN, CAROL D. N88-23728
WIETING, ALLAN R. N88-24001
WILCOX, BRIAN N88-24169
WILCOX, PETER A. N88-23734
WILKINS, S. CURTIS N88-24477
WILLIAMS, J. RICHARD N88-24291
N88-24337
WILLIAMS, JAMES H., JR. N88-23986
N88-23987
WILLIAMS, JEFFERY T. N88-23929
WILLIAMS, LOUIS J. N88-23737
WILLIAMS, R. M. N88-24324
WILLIAMS, ROGER M. N88-24501
WILMS, A. N88-24249
WILSON, D. G. N88-24323
WILSON, DAVID J. N88-23965
WILSON, J. W. N88-24251
WILSON, JOHN C. N88-23809
WILSON, JOHN W. N88-24571
WILSON, T. H., JR. N88-23862
WILTON, DONALD R. N88-23929
WIMMER, J. M. N88-23881
WINFREE, WILLIAM P. N88-23962
WISEMAN, S. R. N88-24167
WITHEROW, WILLIAM K. N88-23960
WITT, W. P. N88-23823
WITTENBERG, L. J. N88-24330
N88-24474
WOLF-GLADROW, DIETER A. N88-24232
WOLF, STANLEY M. N88-23861
WOLK, NANCY E. N88-23905
WOLOSHUN, KEITH A. N88-24396
WONG, ALBERT N88-24364
WONG, CARLA N88-24190
N88-24192
WOOD, CHARLES N88-24503
WOOD, RICHARD M. N88-23765
WOODS, T. G. N88-24147
WOOLF, LARRY D. N88-24449
WU, C. H. N88-24370
WYANT, FRANCIS J. N88-24494
WYATT, BARRY N88-24023

X

XIA, YIREN N88-23993

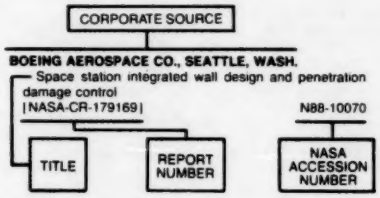
Y

YAMAGUCHI, N. N88-24530
YAMAZAKI, YOSHIHIRO N88-24053
N88-24054
N88-24059
YEE, R. N88-24191
YEH, H. C. N88-23881
YIP, LONG P. N88-23746
YODER, G. L. N88-24322
YU, X. H. N88-24244
N88-24245
N88-24246

Z

ZABIELSKI, CHESTER V. N88-23850
ZHANG, XING N88-23992
ZHAO, L. C. N88-24228
ZISSIS, G. J. N88-24108
ZUCCO, E. N88-23771
ZUSHI, H. N88-24523

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The NASA accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

A

ACADEMY OF SCIENCES OF THE UKRAINIAN SSR, KIEV.
Interaction of slow neutrons with Ge74 single crystals [DE87-703010] N88-24536

AD ASTRA LTD., SANTA FE, N. MEX.
Power requirements for mining and microwave processing of extraterrestrial resources N88-24389

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, NEUILLY-SUR-SEINE (FRANCE).
The Design, Development and Testing of Complex Avionics Systems [AGARD-CP-417] N88-23767

AERITALIA S.P.A., CASELLE TORINESE (ITALY).
Rapid prototyping of complex avionic system architectures N88-23771
The electromagnetic threat to future avionic systems N88-23790

AERITALIA S.P.A., TURIN (ITALY).
Colombus feasibility studies, executive summary [ETN-88-92334] N88-23820

AEROSPACE CORP., ALBUQUERQUE, N. MEX.
Space nuclear reactor shielding optimization studies N88-24320
Space vehicle/nuclear reactor thermal radiation integration issues N88-24417

AEROSPACE CORP., EL SEGUNDO, CALIF.
Disclination structures in carbon and graphite [AD-A191056] N88-23868
The performance of perfluoropolyalkylether oils under boundary lubrication conditions [AD-A191057] N88-23869
Application of chaos theory to 1/f noise [AD-A191150] N88-23935

AEROSPACE MEDICAL RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.
Advanced development of a cockpit automation design support system N88-23785
Designing for design effectiveness of complex avionics systems N88-23788

AGUSTA SISTEMI S.P.A., VARESE (ITALY).
Test philosophy of the EH101 integrated avionic N88-23775

AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
Lightweight power bus for a baseload nuclear reactor in space N88-24505

AIR FORCE ASTRONAUTICS LAB., EDWARDS AFB, CALIF.
Noncryogenic propellants for a nuclear orbit transfer vehicle N88-24444
Solar thermal propulsion for orbit transfer vehicles N88-24445

AIR FORCE INSPECTION AND SAFETY CENTER, KIRTLAND AFB, N. MEX.
The liquid droplet radiator in space: A parametric approach N88-24437

AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OHIO.
A compressible vapor flux model for transient heat pipe analysis N88-24343

AIR FORCE ROCKET PROPULSION LAB., EDWARDS AFB, CALIF.
Direct nuclear propulsion for Earth-to-orbit vehicles N88-24271

AIR FORCE SPACE DIV., LOS ANGELES, CALIF.
EnviroNET: An interactive space-environment information resource [NASA-TM-101137] N88-23812

AIR FORCE TEST PILOT SCHOOL, EDWARDS AFB, CALIF.
A look toward the future of complex avionics systems development using the USAF Test Pilot School's avionics systems test training aircraft N88-23797

AIR FORCE WEAPONS LAB., KIRTLAND AFB, N. MEX.
Air Force space power requirements and nuclear power assessment methodology N88-24378

AIR FORCE WRIGHT AERONAUTICAL LABS., WRIGHT-PATTERSON AFB, OHIO.
Design for interoperability (interchangeability) N88-23789
Proceedings of the 1987 Tri-Service Conference on Corrosion, Volume 2 [AD-A189660] N88-23847
Operational concerns involving a shadow-shielded nuclear reactor for space station applications N88-24257

AIRESEARCH MFG. CO., TORRANCE, CALIF.
Improved silicon nitride for advanced heat engines N88-23881

ALABAMA UNIV., HUNTSVILLE.
Genetic algorithms for adaptive real-time control in space systems N88-24195
Raychaudhuri equation in the self-consistent Einstein-Cartan theory with spin-density [NASA-TM-101145] N88-24546
On the magnetic structure and energy balance of EUV-emitting plasma in the quiet Sun N88-24567

ALASKA UNIV., FAIRBANKS.
Influence of the Yukon River on the Bering Sea [NASA-CR-182802] N88-24126

ARGONNE NATIONAL LAB., IDAHO FALLS, IDAHO.
Fast critical experiment data for space reactors N88-24286

ARGONNE NATIONAL LAB., ILL.
Effects of space-dependent cross sections on core physics parameters for compact fast spectrum space power reactors N88-24263
Considerations pertinent to the Doppler effect for space reactors N88-24264
Interaction of the control system with core nuclear design for fast spectrum space power reactors N88-24304
Monolithic fuel cell based power source for sprint power generation N88-24313
Thermal and power availability transient responses for the Argonne monolithic solid oxide fuel cell N88-24384
Power and energy requirements for electromagnetic launchers N88-24391
A novel plant protection strategy for transient reactors N88-24423
Monolithic fuel cell based power source for burst power generation N88-24450
Benchmark physics experiments for SP-100 N88-24453
Transient analyses of multimegawatt space reactors N88-24456
MMW shielding design and analysis N88-24457
Automatic reactor control system for transient operation N88-24493
Superconducting thin film vertex detector for SSC (Superconducting Super Collider) applications [DE88-005951] N88-24535

ARMY MATERIALS TECHNOLOGY LAB., WATERTOWN, MASS.
Corrosion and corrosion inhibition of metals/alloys in methyphosphonic difluoride N88-23850

AVCO-EVERETT RESEARCH LAB., MASS.
Nuclear reactor magnetohydrodynamic power generator for directed energy weapons N88-24336

AVIONS MARCEL DASSAULT, SAINT-CLOUD (FRANCE).
Modeling of functional specifications for onboard software: Experience with the Rafale avionics system N88-23777
Avionics systems: Development method and computer tools N88-23799
Workshops for the design of avionics systems and the development of onboard software N88-23802

B

BABCOCK AND WILCOX CO., LYNCHBURG, VA.
Small particle bed reactors: Sensitivity to Brayton cycle parameters N88-24487

BELL TELEPHONE MFG. CO., ANTWERP (BELGIUM).
Botany Facility pre-phase C/D. Core payload for EURECA, volume 2 [BF-RP-ER-015-VOL-2] N88-24130
Botany Facility pre-phase C/D. Core payload for EURECA, volume 1 [BF-RP-ER-015-VOL-1] N88-24144

BEN GURION UNIV. OF THE NEGEV, BEERSHEVA (ISRAEL).
Liquid-metal MHD power conversion for space electric systems N88-24338

BOEING AEROSPACE CO., SEATTLE, WASH.
Power source selection for neutral particle beam systems N88-24314

BOEING COMMERCIAL AIRPLANE CO., SEATTLE, WASH.
Integrated Application of Active Controls (IAAC) technology to an advanced subsonic transport project: Program review [NASA-CR-3880] N88-23763

BOEING MILITARY AIRPLANE DEVELOPMENT, WICHITA, KANS.
Crewstation Information and Development System (CIDS) N88-23781

BOWLING GREEN STATE UNIV., OHIO.
IUE evidence on the nature of the innermost broad-line region in Seyfert 1 galaxies N88-24552

BP MINERACAO LTDA., RIO DE JANEIRO (BRAZIL).
Tornado tracks in Southwestern Brazil, Eastern Paraguay, and Northwestern Argentina N88-24071

BRITISH AEROSPACE AIRCRAFT GROUP, PRESTON (ENGLAND).
A structured approach to weapon system design N88-23773

BRITISH AEROSPACE PUBLIC LTD. CO., PRESTON (ENGLAND).
Software engineering for the British Aerospace Experimental Aircraft Programme (EAP) N88-23798

BRITISH AEROSPACE PUBLIC LTD. CO., WOODFORD (ENGLAND).
The specification and design of a future maritime reconnaissance aircraft N88-23772

BROOKHAVEN NATIONAL LAB., UPTON, N. Y.
Polyitaconic acid macromolecule primer for adhesive bonding and corrosion control of aluminum N88-23849
Systematic variation of magnetic-field penetration depth in high-T(c) superconductors studied by muon spin relaxation N88-24243
Comparison between muon spin rotation and neutron scattering studies on the 3-dimensional magnetic ordering of La2CuO(4-y) N88-24244
Coexisting static magnetic ordering and superconductivity in CeCu2.1Si2 found by muon spin relaxation N88-24245
Static magnetic ordering of CeCu2.1Si2 found by muon spin relaxation N88-24246
Search for bound states of the eta-meson in light nuclei N88-24248

Thermal-hydraulic considerations for particle bed reactors N88-24266
Particle bed reactor scaling relationships N88-24267
Nuclear propulsion systems for orbit transfer based on the particle bed reactor N88-24272
Ultra high temperature direct propulsion N88-24275
Theoretical prediction of single phase turbulent flow distribution in particulate bed reactors N88-24386
Analysis of a nuclear orbital transfer vehicle reentry accident N88-24426

BROWN UNIV., PROVIDENCE, R. I.
Theoretical studies of Resonance Enhanced Stimulated Raman Scattering (RESRS) of frequency doubled Alexandrite laser wavelength in cesium vapor
[NASA-CR-182871] N88-23841

BUNDESMINISTERIUM FUER FORSCHUNG UND TECHNOLOGIE, BONN (WEST GERMANY).
Arguments for manned or unmanned spacecraft activities
[REPT-46/87] N88-23813

C

CALIFORNIA STATE UNIV., LONG BEACH.
Fluid dynamics of spherical cavity reactors N88-24291
Fundamental analysis of space nuclear-MHD generator for gigawatt-level power N88-24337

CALIFORNIA UNIV., BERKELEY.
Studies of heat and mass transfer during chemical vapor deposition N88-23953
Scientific computing environments
[AD-A191239] N88-24175

CALIFORNIA UNIV., LOS ANGELES.
Point accessibility and primary workspace of simple six-link robots N88-23976
A theoretical model of the washout of trace gases by raindrops in the atmosphere N88-24125
Theoretical and experimental investigation of swirl flow phase separators for microgravity applications N88-24335
Transient analysis of heat pipe vapor dynamics N88-24341
Progress in the computer modeling of the liquid phase behavior of a liquid metal heat pipe N88-24342
Advanced LMMHD space power generation concept N88-24364
Development of a lightweight structure with load bearing capability and high thermal conductance N88-24393
Evaluation of UN fuel pin failure modes and motion of fuel during severe accidents for reactors in space N88-24424
Experimental investigation of a microgravity separator for two phase mixtures containing small volumes of gas/vapor N88-24468

CALIFORNIA UNIV., SANTA CRUZ.
Analysis of dust grain properties in two star forming regions through comparison of theoretical models to observations N88-24559
Stable, heavy, neutral particles in the sun and in toponium decay N88-24568

CAMBRIDGE ACOUSTICAL ASSOCIATES, INC., MASS.
Analytical modeling of the structureborne noise path on a small twin-engine aircraft
[NASA-CR-4136] N88-24233

CANADA CENTRE FOR REMOTE SENSING, OTTAWA (ONTARIO).
Practical image analysis using personal computers: The Canadian experience N88-24037

CASE WESTERN RESERVE UNIV., CLEVELAND, OHIO.
Colloidal characterization of silicon nitride and silicon carbide N88-23883
Polymer precursors for SiC ceramic materials N88-23889

CENTRE D'ESSAIS AERONAUTIQUE TOULOUSE (FRANCE).
Investigation of the long term effects of aging on carbon epoxy composites exposed naturally to the weather under cyclic loads. (Results of sampling after 2.5 years). Test report M1-641300
[CEAT-39/M/79-C-M1-641300] N88-23834
Brief evaluation of the alloy 17-4-PH (Z5 CNU 17-04). Semifinished product: 205 mm dia forged roller, test reports
[DF/NH-3616/84] N88-23866

CENTRE D'ETUDES ET DE RECHERCHES DE MEDECINE AEROSPATIALE, PARIS (FRANCE).
Psychosensory cockpit ergonomics, advantages of intelligent information systems N88-23784

CENTRE NATIONAL D'ETUDES SPATIALES, TOULOUSE (FRANCE).
Ariane 4 pyrotechnics system: Definition of the chains and pyrotechnic devices
[CNES-88/CT/DRT/TVE/IL/25] N88-23816

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, TOULOUSE (FRANCE).
Simultaneous use of artificial intelligence and Petri nets: Application to the monitoring of a fabrication plan
[LAAS-87-354] N88-24207

CINCINNATI UNIV., OHIO.
A design analysis for an automated robotic workpiece manipulator N88-23975
BIFOLD: A dual-mode nuclear space power system N88-24292

CIVIL AVIATION AUTHORITY, LONDON (ENGLAND).
UK airmiss statistics
[CAA-1/87] N88-23761

COLLEGE OF WILLIAM AND MARY, WILLIAMSBURG, VA.
Muon motion in titanium hydride N88-24247

COLOGNE UNIV. (WEST GERMANY).
An introduction to poloidal and toroidal fields
[MITT-54] N88-24232

COLORADO UNIV., BOULDER.
Cloud cover determination in polar regions from satellite imagery
[NASA-CR-182906] N88-24123

COLUMBIA UNIV., NEW YORK, N.Y.
Research investigation directed toward extending the useful range of the electromagnetic spectrum
[AD-A190198] N88-23920
Research investigation directed toward extending the useful range of the electromagnetic spectrum, appendix
[AD-A190199] N88-23921

COMISION NACIONAL DE INVESTIGACIONES ESPACIALES, BUENOS AIRES (ARGENTINA).
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24020
Shape detection in remote sensing through graph isomorphism N88-24028
Spectral measurements for correcting LANDSAT data for atmospheric effects N88-24066
COMTAL vision one/20 programming processor system from the VAX 11/780 N88-24079

COMMISSARIAT A L'ENERGIE ATOMIQUE, GIF-SUR-YVETTE (FRANCE).
Status of CEA design and simulation studies of a 200 KWe turboelectric space power system N88-24268

COMMISSARIAT A L'ENERGIE ATOMIQUE, SACLAY (FRANCE).
Comparison of 20-kWe space nuclear power systems: Impact of reactor temperature and technology upon system design and performances N88-24475

COSTELLO (FREDERICK A.), INC., HERNDON, VA.
Detailed transient model of a liquid-metal heat pipe N88-24345

D

DEFENCE AND CIVIL INST. OF ENVIRONMENTAL MEDICINE, DOWNSVIEW (ONTARIO).
Experience in the integration of human engineering effort with avionics systems development N88-23793

DEPARTMENT OF DEFENSE, WASHINGTON, D. C.
Defense Small Business Innovation Research Program (SBIR). Volume 3: Air Force abstracts of phase 1 awards, 1987 N88-24548

DEPARTMENT OF ENERGY, WASHINGTON, D. C.
Development and implementation of a space nuclear safety program N88-24361
The dynamic isotope power system: Technology status and demonstration program N88-24400
United Nations deliberations of the use of nuclear power sources in space: 1978-1987 N88-24410

DIRETORIA DE SERVICO GEOGRAFICO DO EXERCITO, SAO PAULO DOS CAMPOS (BRAZIL).
Thematic mapping utilizing data from the Thematic Mapper sensor of the LANDSAT satellite N88-24060

DORNIER-WERKE G.M.B.H., FRIEDRICHSHAFEN (WEST GERMANY).
Colombus feasibility studies, executive summary
[ETN-88-92334] N88-23820

DU PONT DE NEMOURS (E. I.) AND CO., AIKEN, S.C.
Weldability of general purpose heat source iridium capsules N88-24429

E

EBASCO SERVICES, INC., NEW YORK.
A liquid metal MHD concept for multimegawatt space power application N88-24348
A multimegawatt space power source radiator design N88-24436

ECOLE DES MINES, PARIS (FRANCE).
Mechanical and structural characterization of aluminum ceramic fibers
[ETN-88-92168] N88-23870

ECOLE NATIONALE SUPERIEURE DES TELECOMMUNICATIONS, PARIS (FRANCE).
Modeling, filtering and control of stochastic processes
[ENST-87E021] N88-23925

EDGERTON, GERMESHAUSEN AND GRIER, INC., ROCKLEDGE, FLA.
Critical nuclear launch issues: A perspective from the State of Florida N88-24412

ELECTRONIQUE SERGE DASSAULT, ST. CLOUD (FRANCE).
Testing complex avionics software: A practical experience N88-23794

EMPRESA BRASILEIRO DE PESQUISA AGROPECUARIA, PLANALTINA.
Identification of areas cultivated with soybeans in the cerrados regions, through digital processingof satellite images: A methodological approach N88-24048

ENERGY TECHNOLOGY ENGINEERING CENTER, CANOGA PARK, CALIF.
Optimization of SP-100 thermoelectric electromagnetic pump N88-24382
SP-100 flight qualification testing assessment N88-24414
Liquid metal testing at ETEC for the SP-100 program N88-24446

ENGINEERING AND ECONOMICS RESEARCH, INC., VIENNA, VA.
Research and Technology, 1987, Goddard Space Flight Center N88-24572

ENGINEERING AND SCIENCE CONSULTANTS, GRAFTON, VA.
Boundary-layer stability and airfoil design N88-23738

ENVIRONMENTAL RESEARCH INST. OF MICHIGAN, ANN ARBOR.
Orbital navigation, docking and obstacle avoidance as a form of three dimensional model-based image understanding N88-24194

EUROPEAN SPACE AGENCY, PARIS (FRANCE).
Preparing for the new programs. The ESA technological research and development program 1988-1990
[ESA-SP-1095] N88-23814
International cooperation in remote sensing: The ESA experience N88-24038
Presentation of the METEOSAT system and the roles of EUMETSAT within the meteorological community N88-24039
ERS-1 data products and services and their value for tropical countries N88-24040
The high-throughput X-ray spectroscopy mission E6889478 MN513835
[ESA-SP-1092] N88-24554

EUROPEAN SPACE AGENCY. EUROPEAN SPACE RESEARCH AND TECHNOLOGY CENTER, ESTEC, NOORDWIJK (NETHERLANDS).
Structural acoustics design manual
[ESA-PSS-03-1201-ISSUE-1] N88-23821
Insert design handbook
[ESA-PSS-03-1202-ISSUE-1] N88-23822
Unified interchange format for computer data (standard file format)
[ESA-STR-225] N88-24183

F

FAIRCHILD SPACE AND ELECTRONICS CO., GERMANTOWN, MD.
Pioneer 10 and 11 RTG performance update N88-24301

FEDERAL AVIATION ADMINISTRATION, KANSAS CITY, MO.
Certification aspects of airplanes which may operate with significant natural laminar flow N88-23749

FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.
Advisory circular: Noise certification handbook
[FAA-AC-36-4B] N88-24234

FERMI NATIONAL ACCELERATOR LAB., BATAVIA, ILL.
Quark core stars, quark stars and strange stars
[DE88-006991] N88-24555

FLORIDA INST. OF TECH., MELBOURNE.
A proposed national policy concerning the reentry of space reactors N88-24359

FLORIDA INTERNATIONAL UNIV., MIAMI.
Automatic program generation from specifications using PROLOG N88-24196

FLORIDA UNIV., GAINESVILLE.
Acoustical gas core reactor with MHD power generation for burst power in a bimodal system N88-24290
Burst power gas core reactor with MHD power generation N88-24472

FORD MOTOR CO., DEARBORN, MICH.
Improved silicon carbide for advanced heat engines N88-23879
Sodium heat engine/AMTEC system experiments N88-24325

Performance of vapor-fed sodium heat engine/AMTEC systems N88-24502

FUNDACAO UNIV. DO RIO GRANDE (BRAZIL).
Evaluation of the floodable area of the canal of Sao Goncalo through TM-LANDSAT 5 imagery N88-24078
Evaluation of a flood period (June, 1984) in the southern region of Laguna dos Patos, through remote sensing data, meteorological and oceanographic N88-24083

G

GA TECHNOLOGIES, INC., SAN DIEGO, CALIF.
A review of thermionic power conversion systems for SDI applications N88-24310
Spectroscopic measurements of ion temperature, rotation speed and beam deposition profile on DIII-D N88-24519

GARRETT FLUID SYSTEMS CO., TEMPE, ARIZ.
Foil gas bearing system endurance testing dynamic isotope power system N88-24302
Characteristics of the closed Brayton cycle for dynamic isotope power systems N88-24401
The closed Brayton cycle: An energy conversion system for near-term military space missions N88-24488

GARRETT TURBINE ENGINE CO., PHOENIX, ARIZ.
Thermal cyclic durability testing of ceramic materials for turbine engines N88-23886

GENERAL ACCOUNTING OFFICE, WASHINGTON, D. C.
National aero-space plane: A technology development and demonstration program to build the X-30 [GAO/NSIAD-88-122] N88-23764

GENERAL ELECTRIC CO., PHILADELPHIA, PA.
The multi-disciplinary design study: A life cycle cost algorithm [NASA-CR-4156] N88-24172
Nuclear electric power for multimegawatt orbit transfer vehicles N88-24261
Space based radar application to air traffic control N88-24262
MHW RTG performance during LES 8/9 and Voyager missions N88-24300
Radiation hardening design of nuclear powered spacecraft N88-24315
Analysis of thermal and radiation effects in materials using the GEMAT process N88-24318
Turbomachinery in space N88-24321
Status of modular RTG technology N88-24403
Ceramic electrical insulator development for thermoelectric SACE power system N88-24459
Apparatus for the measurement of resistivity of glasses and ceramics N88-24460

GENERAL ELECTRIC CO., SUNNYVALE, CALIF.
Material tradeoffs to minimize flooding reactivity N88-24265
Reactor instrumentation and control design and performance simulation for SP-100 N88-24306
SP-100 control system modeling N88-24356

GENERAL MOTORS CORP., INDIANAPOLIS, IND.
Nondestructive Evaluation (NDE) of structural ceramics by photoacoustic microscopy N88-23884

GENERAL RESEARCH CORP., SANTA BARBARA, CALIF.
A software life cycle support environment N88-23800

GENEVA OBSERVATORY (SWITZERLAND).
Stochasticity in elliptical galaxies [SER-C-PREPUBL-FASC-20] N88-24556

GEORGE WASHINGTON UNIV., WASHINGTON, D.C.
Wind-tunnel investigation of actuated forebody strakes for yaw control at high angles of attack N88-23754

GREGORY GEOSCIENCE LTD., OTTAWA (ONTARIO).
Remote sensing and data integration: Practical solutions for resource managers N88-24034

GRENOBLE-1 UNIV. (FRANCE).
Subthreshold pion production in proton induced reactions at 180 to 201 MeV and He3 at 283 MeV [ETN-88-92303] N88-24250

GRENOBLE-1 UNIV., SAINT MARTIN D'HERES (FRANCE).
Conversational Analysis of Color Images (CAICOU): An interactive development system for the analysis of color images [RR-641-I-IMAG-39-LIFIA] N88-23964
On a classification of problems on sets of bilinear forms by formal polynomials [RR-642-I-IMAG-53-LIFIA] N88-24219

GRUMMAN AEROSPACE CORP., BETHPAGE, N.Y.
Dynamic isotope power system critical component verification N88-24421

H

HAMILTON STANDARD, WINDSOR LOCKS, CONN.
TES: A modular systems approach to expert system development for real-time space applications N88-24197

HAMPDEN-SYDNEY COLL., VA.
Neutron radiation tolerance of Au-activated silicon N88-24316

HANFORD ENGINEERING DEVELOPMENT LAB., RICHLAND, WASH.
Conceptual design of the SP-100 GES test site N88-24264

HIROSHIMA UNIV. (JAPAN).
Cascade fluorescences from laser-excited lithium atom for plasma diagnostics N88-24526

HOUSTON UNIV., TEX.
An investigation of conformable antennas for the astronaut backpack communication system [NASA-CR-182908] N88-23929
Precise computer controlled positioning of robot end effectors using force sensors [NASA-CR-182887] N88-24213

HUGHES AIRCRAFT CO., FULLERTON, CALIF.
Operation and performance of an integrated helicopter communication system N88-23787

I

IBGE/DRN/BA SEPLAN, SALVADOR (BRAZIL).
Lithostructural interpretation of Chapda do Cachimbo (Pa-Am-Mt), based on radar and LANDSAT imagery N88-24100

IDAHO NATIONAL ENGINEERING LAB., IDAHO FALLS.
Requirements and cost considerations for a combined space nuclear reactor test facility N88-24277
Ammonia cleanup of lithium containing components N88-24287
ATHENA heat pipe transient model N88-24344
ATHENA simulation of the 300 kW SP-100 N88-24357
Expert systems approach to modeling systems with the ATHENA thermal-hydraulics code N88-24365
Comparison of a direct thrust nuclear engine, nuclear electric engine and a chemical engine for future space missions N88-24379
Gas core reactors for direct nuclear propulsion N88-24442
Low cross-section Mo-Nb thermocouples for nuclear application: The state-of-the-art N88-24477
Test plan and facilities for qualifying nuclear rocket fuel elements N88-24482

ILLINOIS UNIV., CHICAGO.
Electromagnetic scattering from nonlinear anisotropic cylinders N88-23930

ILLINOIS UNIV., URBANA.
Mentat: An object-oriented macro data flow system [NASA-TM-101165] N88-24199

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND).
A generalized variational method for solving stress intensity factors at cracks on the edge of holes in orthotropic plates [IC-AERO-87-02] N88-23992

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE, CALCUTTA.
Landuse and landform studies of the Mahanadi River Delta with the help of satellite MSS band N88-24033

INDUCTION GENERAL, INC., PITTSBURGH, PA.
High frequency power distribution system [NASA-CR-175071] N88-23939

INSTITUT D'AERONOMIE SPATIALE DE BELGIQUE, BRUSSELS.
The potential impact on atmospheric ozone and temperature of increasing trace gas concentrations [NASA-CR-182965] N88-24112

INSTITUT DE MECANIQUE DE GRENOBLE (FRANCE).
Studies for the definition of a Faraday converter for space nuclear systems N88-24339

INSTITUT DE MECANIQUE DES FLUIDES DE LILLE (FRANCE).
Study of a system for reducing base drag by controlling vortices [REPT-87/43] N88-23730

INSTITUT DE MECANIQUE DES FLUIDES DE MARSEILLE (FRANCE).
Realization of an XeCl laser producing 100W on average [ETN-88-92541] N88-23970

INSTITUT NATIONAL DES SCIENCES APPLIQUEES DE LYON, VILLEURBANNE (FRANCE).
Modeling of cavitation phenomena in homogeneous flow in transitory regimes in pipes [ISAL-IDI1-87-15] N88-23948

INSTITUT NATIONAL POLYTECHNIQUE, GRENOBLE (FRANCE).
Structure and mechanical properties of metal matrix composites made using semi-solid processes: The case of the system Al-Si/SiC [ETN-88-92299] N88-23836
Monolithic integration on a GaAs substrate of a quarter ring laser and an optical guide coupled by an evanescent wave [ETN-88-92308] N88-23969
Application of spline functions to digital image processing [ETN-88-92194] N88-24218
Enhancement of second harmonic generation on silver gratings by resonant excitation of surface plasmon [ETN-88-92304] N88-24509

INSTITUT NATIONAL POLYTECHNIQUE, NANCY (FRANCE).
State-of-the-art in true space-time finite element method N88-24215

INSTITUTO DE CARTOGRAFIA AERONAUTICA, RIO DE JANEIRO (BRAZIL).
A system for determination of wind fields using geostationary meterological satellites N88-24056
Geometric image correction: An approach for the registration of LANDSAT-TM digital images supported by topographical maps of medium and great scales N88-24061

INSTITUTO DE ECONOMIA E PESQUISAS, ARACAJU (BRAZIL).
Study of fracturing for groundwater research in the Sergipe state with remote sensing products N88-24052

INSTITUTO DE PESQUISAS ESPACIAIS, SAO JOSE DOS CAMPOS (BRAZIL).
Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, volume 1 N88-24013
A proposal for a project entitled assessment of forest resources in Uruguay submitted to the United Nations Industrial Development Organization (UNIDO) N88-24016
Comparison of surface current determined from satellite-tracked buoy with shipboard wind data during the 4th Brazilian antarctic expedition, 10-14 March, 1986 N88-24024
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24026
Textural features for image classification in remote sensing N88-24027
The modeling of error budget analysis and tolerance specifications for BRESEX multiband linear array CCD camera N88-24029
Anomalies in the vegetation in the Alto Xingu - MT N88-24043
Remote sensing techniques in the estimation of the area cultivated with beans, corn, and castor beans in the Irece County (Bahia State) N88-24045
CANASATE: Sugar cane mapping by satellite N88-24046
Spectral behavior of crops through analysis of LANDSAT-TM data N88-24047
Structure and dynamics of vegetation in the middle semi-arid tropics. Quixaba's Caatinga (PE): Terrain analysis of MSS/LANDSAT data N88-24049
Remote sensing and structural rupture: Application examples in the study of tectonics N88-24050
Processing of HRPT data from the NOAA series satellites N88-24053
Navigation system from AVHRR data from NOAA series satellites N88-24054
Comparison of the solar radiation estimation method by satellites N88-24055
Digital processing of infrared and visible images from the GOES satellite and its integration with meteorological radar data N88-24057
Near surface current determined from INPE's satellite-tracked buoy, during 6-26 November, 1985 N88-24058
Tiros operational vertical sounder (TOVS) and radiosonding in the region N88-24059
Generation of thematic maps for updating aeronautical pilot charts utilizing LANDSAT-TM images N88-24062
Evolution of a family of image processing systems at INPE N88-24065
Study of methods of post-processing applied to a problem of standard classification N88-24067
A proposal of adaptation of a knowledge-based scene analysis model to some remote sensing problems N88-24068
Utilization of LANDSAT-TM , for aiding in the localization of archeological sites in the state of Sao Paulo N88-24069
Analysis of the parameters responsible for the variations of the illumination conditions in the LANSAT data N88-24070

Interpretation of MSS/LANDSAT data for evaluation of physical distribution of mangroves in Cananeia-Iguape (SP) N88-24072
Evaluation of a burned area and the vegetation regeneration affected by the burning in the Parque Nacional de Brazilia through TM/LANDSAT data N88-24073
Low altitude remote sensing data in the implementation of a mathematical model for the planning of urban equipment networks N88-24074
Evaluation of an estimation system for an irrigated area in a tropical region through TM-LANDSAT imagery N88-24075
Study of reservoir water quality utilizing remote sensing techniques: Methodological concepts N88-24076
Evaluation of the floodable area of the canal of Sao Goncalo through TM-LANDSAT 5 imagery N88-24078
Automatic registration of satellite imagery N88-24080
Visualization of digital terrain models N88-24081
Application of its transformation in color enhancement of LANDSAT imagery N88-24082
Evaluation of a flood period (June, 1984) in the southern region of Laguna dos Patos, through remote sensing data, meteorological and oceanographic N88-24083
Restrictions in activity monitoring through remote sensing N88-24084
Detection of biomass burning and smoke plumes in the Amazon region through NOAA satellite imagery N88-24085
Evaluation of the mangrove area at the Piaui River (SE) through remote sensing N88-24086
Mapping of plant associations and the variation of surface water in the Pantanal Mato-Grossense National Park, through remote sensing techniques N88-24092
Preliminary study on the application of digital processing of TM-LANDSAT data in the mapping of apple orchards in Fraiburgo (SC) N88-24093
Temporal analysis of the changes in Parque Estadual de Jacupiranga vegetation through digital treatment of LANDSAT imagery N88-24094
Evaluation of TM false color composites for crop discrimination N88-24096
Some geological aspects of the Pirapemas Lineament Belt N88-24099

INTERNATIONAL BUSINESS MACHINES CORP., OWEGO, N.Y.
Development of a generic architecture N88-23774
Systems engineering technique N88-23776
The avionics software architecture impact on system architecture N88-23778

IOWA UNIV., IOWA CITY.
Surface curvature and pressure gradient effects on turbulent flow: An assessment based on numerical solution of the Reynolds equations N88-23954
A robotic language for cooperative multi-robots N88-24186

J

JAPAN ATOMIC ENERGY RESEARCH INST., IBARAKI.
Ion temperature measurement with spectroscopy in JT-60 N88-24513

JET PROPULSION LAB., CALIFORNIA INST. OF TECH., PASADENA.
Noncontact true temperature measurement, 2 N88-23911
Infrared radiometric technique in temperature measurement N88-23913
Environmental projects. Volume 6: Environmental assessment. New 34-meter antenna at Venus site [NASA-CR-182922] N88-23919
The Shuttle Imaging Radar B (SIR-B) experiment report [NASA-CR-182923] N88-23932
MSAT-X: A technical introduction and status report [NASA-CR-182921] N88-23933
Chemical kinetics and photochemical data for use in stratospheric modeling evaluation Number 8 [NASA-CR-182919] N88-24012
Radar penetration in the Amazonian rain forest N88-24015
Airborne and spaceborne radar images for geologic and environmental mapping in the Amazon rain forest, Brazil N88-24021
Radar penetration in the Amazonian rain forest N88-24044
ECUT (Energy Conversion and Utilization Technologies) program: Biocatalysis Project [NASA-CR-182917] N88-24110
The results of application studies for space nuclear power N88-24259
AMTEC electrode development N88-24324
Civil missions applications study N88-24376
High power density electrodes for AMTEC N88-24501
Improved GaP doped SiGe thermoelectric material N88-24503

JOHNS HOPKINS UNIV., BALTIMORE, MD.
Tokamak studies of density sensitive line ratios N88-24521

JOINT EUROPEAN TORUS PROJECT, ABINGDON (ENGLAND).
Spectroscopic results from JET: Some examples of data comparison and data needs N88-24517

JOINT INST. FOR NUCLEAR RESEARCH, DUBNA (USSR).
Specific features of emanation, temperature and hydrodynamic fields in the epicentral zone of tectonic earthquake [DE88-701140] N88-24114

K

KANSAS UNIV., LAWRENCE.
Three-dimensional curved shell and solid-shell transition finite elements with temperature and temperature gradients as primary variables for steady state heat conduction N88-23997
Research on enhancing the utilization of digital multispectral data and geographic information systems in global habitability studies [NASA-CR-182799] N88-24101

KENTUCKY UNIV., LEXINGTON.
Low gravity thermal management using dielectrophoretic forces N88-24470

KERNFORSCHUNGSANLAGE, JUELICH (WEST GERMANY).
Effect of test sample geometry on the fatigue crack growth of X10NiCrAlTi 32 20 and NiCr22 Co 12Mo [JUEL-SPEZ-399] N88-23990
Flux density measurements of neutral iron in TEXTOR with laser induced fluorescence N88-24528

KYOTO UNIV. (JAPAN).
Density diagnostics by hydrogen line intensity ratios: Excitation cross section between excited states N88-24522
Spectroscopic study of heliotron E plasmas: Stark profile, CXR, poloidal rotation and carbon coating N88-24523
Observation of injected silicon in heliotron E N88-24524
Polarization spectroscopy: Prospect and data needs N88-24531

L

LAWRENCE LIVERMORE NATIONAL LAB., CALIF.
Gas-cooled reactor power systems for space N88-24350
Nuclear safety as applied to space power reactor systems N88-24360
Spectral modelling of the soft gamma ray repeater [DE88-007027] N88-24570

LEHIGH UNIV., BETHLEHEM, PA.
Carboxylate formation at the interface between a polyimide coating and cobalt N88-23859
A control technique for improved robot performance N88-24212

LITTON TECHNISCHE WERKE, FREIBURG (WEST GERMANY).
A comparison of integrated and separate systems for flight control and navigation N88-23779

LOCKHEED AERONAUTICAL SYSTEMS CO., MARIETTA, GA.
Acoustically excited heated jets. 1: Internal excitation [NASA-CR-4129-PT-1] N88-23751
Acoustically excited heated jets. 2: In search of a better understanding [NASA-CR-4129-PT-2] N88-23752
Acoustically excited heated jets. 3: Mean flow data [NASA-CR-4129-PT-3] N88-23753

LOCKHEED-CALIFORNIA CO., BURBANK.
Fuel containment, lightning protection and damage tolerance in large composite primary aircraft structures [NASA-CR-3875] N88-23839

LOCKHEED ENGINEERING AND MANAGEMENT SERVICES CO., INC., HOUSTON, TEX.
A generic multibody simulation [NASA-CR-182949] N88-24198

LOCKHEED ENGINEERING AND MANAGEMENT SERVICES CO., INC., WASHINGTON, D.C.
USSR Space Life Sciences Digest, Issue 17 [NASA-CR-3922(20)] N88-24155

LOCKHEED-GEORGIA CO., MARIETTA.
Preventing aircraft corrosion by predictive corrosion modeling N88-23863

LOCKHEED MISSILES AND SPACE CO., GREENBELT, MD.
TALOS: A distributed architecture for intelligent monitoring and anomaly diagnosis of the Hubble Space Telescope N88-24193

LOCKHEED MISSILES AND SPACE CO., PALO ALTO, CALIF.
Development of microencapsulated DNBM quaternary ammonium inhibitors for paints N88-23851
The role of oxygen on the mechanical behavior of molybdenum alloys N88-24278

LOS ALAMOS NATIONAL LAB., N. MEX.
Free electron lasers in strategic defense [DE88-007024] N88-24231
History of some direct nuclear propulsion developments since 1946 N88-24270
Irradiation test results on thermionic fuel element sheath insulators N88-24280
The Light-Weight Radioisotope Heater Unit (LWRHU): Development and application N88-24299
An adaptive load-following control system for a space nuclear power system N88-24307
A review of impact design criteria for space power heat rejection systems N88-24333
Thermochemical analysis of mass transfer in a NB-1ZR-potassium heat pipe N88-24346
Development and implementation of a space nuclear safety program N88-24361
Fabrication of SP-100 fuel barrier structures by chemical vapor deposition N88-24371
Nuclear-powered space debris sweeper N88-24380
Individual satellite power requirements calculated from specified constellation performance N88-24392
HTPIPE: A steady state heat pipe analysis program N88-24396
The THROHPUT code: Thermohydraulic heat pipe modeling N88-24399
Heat pump-augmented systems for spacecraft thermal management N88-24419
Reactor core coolability with reduced power levels N88-24425
The application of high-rate biaxial testing to the design of containment vessels for radioisotope heat sources N88-24428
Polymer fuel cell as an energy storage component for space power applications N88-24452

M

MACDONALD, DETTWILER AND ASSOCIATES LTD., RICHMOND (BRITISH COLUMBIA).
Mapping from LANDSAT and SPOT satellite imagery N88-24018

MARTIN MARIETTA AEROSPACE, DENVER, COLO.
Teleoperator human factors study [NASA-CR-178930] N88-24162

MARTIN MARIETTA ENERGY SYSTEMS, INC., OAK RIDGE, TENN.
Nuclear Rankine/flywheel MMW space power concept N88-24349

MARYLAND UNIV., BALTIMORE.
Evaluation of the endogenous glucocorticoid hypothesis of denervation atrophy [NASA-CR-182848] N88-24157

MARYLAND UNIV., COLLEGE PARK.
Engineering planetary lasers for interstellar communication [NASA-CR-180780] N88-23825
Models and metrics for software management and engineering [NASA-CR-182953] N88-24200

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Investigation of air transportation technology at Massachusetts Institute of Technology, 1986 N88-23716
Experimental measurements of heat transfer from an iced surface during artificial and natural cloud icing conditions [AIAA-PAPER-86-1352] N88-23718
Travelling wave concepts for the modeling and control of space structures [AD-A191235] N88-23819
Common but unappreciated sources of error in one, two, and multiple-color pyrometry N88-23907
Real time thermal imaging of high temperature semiconductor melts N88-23914
Input-output characterization of fiber composites by SH waves [NASA-CR-4153] N88-23986
Characterization of noncontact piezoelectric transducer with conically shaped piezoelement [NASA-CR-4151] N88-23987
Application of the reactivity constraint approach to the transient control of spacecraft reactors N88-24305

Experimental evaluation of the MIT-SNL period-generated minimum time control laws for the rapid adjustment of reactor power N88-24494

MASSACHUSETTS UNIV., AMHERST.
Molecular gas in Virgo cluster spiral galaxies N88-24557

MAX-PLANCK-INSTITUT FUER STROEMUNGSFORSCHUNG, GOETTINGEN (WEST GERMANY).
Tests on oscillating flows in a pipe nozzle with an abrupt diameter variation
[MPIS-2/1987] N88-23947
Experiments on reactions of the electronically excited molecule nitron NH (a sup 1 delta) and carbon CH2 (a bar sup 1 A(1)) in gas phase
[MPIS-3/1987] N88-24249

MCDONNELL-DOUGLAS ASTRONAUTICS CO., HOUSTON, TEX.
Advanced EVA system design requirements study N88-24147

MCDONNELL-DOUGLAS ASTRONAUTICS CO., HUNTINGTON BEACH, CALIF.
Liquid droplet radiator development N88-24415
Nuclear propulsion: Past, present and future N88-24441

MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., BREMEN (WEST GERMANY).
Colombus feasibility studies, executive summary
[ETN-88-92334] N88-23820

MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., OTTOBRUNN (WEST GERMANY).
Botany Facility pre-phase C/D. Core payload for EURECA, volume 2
[BF-RP-ER-015-VOL-2] N88-24130
Life Support Subsystem (LSS). Concept for the Botany Facility
[TN-RB524-107/86] N88-24131
Impact of control errors on the volume/weight demand of the Ventilation and Dryer (VAD) concept
[TN-RB524-006/87] N88-24132
Summary of the activities performed during the Botany Facility (BF) predevelopment phase for the Life Support S/S (LSS)
[TB-RB524-002/87] N88-24133
Examination of methods for pollen storage and dispersal
[TN-RB524-097/86] N88-24134
Botany Facility. Thermal Control (TC) subsystem test report on experiment container of laboratory model and breadboard centrifuge
[BF-TN-ER-061/86] N88-24135
Botany Facility: Test report on breadboard tests for the determination of the heat transfer at the glass disk and of the temperature distribution in the fluorescent tube
[BF-TN-ER-053] N88-24136
Botany Facility pre-phase C/D. Core payload for EURECA, volume 1
[BF-RP-ER-015-VOL-1] N88-24144

METEOROLOGICAL SATELLITE CENTER, TOKYO (JAPAN).
Meteorological Satellite Center Technical Note No. 16
[ISSN-0388-9653] N88-24003
Prospects of satellite wind sensing systems in the years 1995-2000 N88-24004
Latitudinal and seasonal variation of the cloud characteristic parameters and their effects on the cloud classification N88-24005
Estimation of total Outgoing Longwave Radiation (OLR) flux from geostationary meteorological satellite infrared window radiance N88-24006
Outline of the GPCP strategy N88-24007
VISSR line number monitoring system N88-24008
Some problems with regard to the TOVS processing detected by using NOAA-HRPT data check program N88-24009
Open cell associated with warm advection N88-24010
Enhanced infra-red picture of LR-FAX for spring and autumn seasons N88-24011

METRAFLU, ECULLY (FRANCE).
Investigation of intensity and phase fluctuations of an acoustic wave after crossing thermal turbulence
[ETN-88-92542] N88-24238

MICHIGAN UNIV., ANN ARBOR.
Nucleate pool boiling: High gravity to reduced gravity; liquid metals to cryogens N88-24464

MICROTECNICA, TURIN (ITALY).
Botany Facility pre-phase C/D. Core payload for EURECA, volume 2
[BF-RP-ER-015-VOL-2] N88-24130
Botany Facility pre-phase C/D. Core payload for EURECA, volume 1
[BF-RP-ER-015-VOL-1] N88-24144

MIDWEST RESEARCH INST., KANSAS CITY, MO.
Direct emissivity measurements on liquids and corrections to multi-color pyrometers N88-23906

MINERACAO TABOCA S.A., MANAUS (BRAZIL).
Criteria for planimetric and altimetric correction of maps restituted from aerial photographs in 1:100,000 scale N88-24097

MINNESOTA MINING AND MFG. CO., ST. PAUL.
Surface conditioning products as tools for corrosion removal and corrosion prevention N88-23856
Water based primers for structural adhesive bonding of aircraft N88-23862

MISSOURI UNIV., COLUMBIA.
Space based nuclear-pumped laser/reactor concepts N88-24289
Defects in cubic silicon carbide on silicon N88-24317
Point defects in irradiated silicates N88-24319
Neutronics conceptual design of a UF6-fueled gasesous laser system N88-24405

MISSOURI UNIV., ROLLA.
Modeling of radiation dose dependence of MOSFETs N88-24370

MITRE CORP., BEDFORD, MASS.
MIPS: The good, the bad and the useful
[NASA-CR-182893] N88-24184

N

NAGOYA UNIV. (JAPAN).
Summary report on the Japan-US Workshop on the Assessment of Spectroscopic Data for Temperature and Density Measurements
[IPPJ-861] N88-24512
X-ray spectroscopic diagnostics on JIPPT-IIU and HELIOTRON-E N88-24515
Helium-like titanium spectra from tokamak plasmas N88-24516
Ion temperature profile measurement using charge exchange recombination spectroscopy on JIPP T-IIU N88-24518
Forbidden transitions as ion-temperature sensitive lines N88-24520
Spectroscopic data relevant to alpha particle diagnostics N88-24527
Measurements of Z(sub eff) profile with a visible bremsstrahlung continuum detector array N88-24529

NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL, WASHINGTON, D. C.
Agenda for advancing electrochemical science and technology N88-23861

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D.C.
Noncontact Temperature Measurement
[NASA-CP-2503] N88-23895
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 311)
[NASA-SP-7011(311)] N88-24161
NASA thesaurus: Astronomy vocabulary
[NASA-SP-7069] N88-24553
Reflectance spectroscopy in planetary science: Review and strategy for the future
[NASA-SP-493] N88-24564

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CALIF.
PAN AIR analysis of the NASA/MCAIR 279-3: An advanced supersonic V/STOL fighter/attack aircraft
[NASA-TM-86838] N88-23750
Flight testing a V/STOL aircraft to identify a full-envelope aerodynamic model
[NASA-TM-100996] N88-23762
Space Station Human Factors Research Review. Volume 1: EVA Research and Development
[NASA-CP-2426-VOL-1] N88-24145
Subsea approach to work systems development N88-24146
Space Station Human Factors Research Review. Volume 4: Inhouse Advanced Development and Research
[NASA-CP-2426-VOL-4] N88-24148
Space station proximity operations and window design N88-24149
Image management research N88-24150
NASA-Ames workload research program N88-24151
Spatial cognition N88-24152
Virtual interface environment N88-24153
MTK: An AI tool for model-based reasoning N88-24189
Integration of symbolic and algorithmic hardware and software for the automation of space station subsystems N88-24190
Connecting remote systems for demonstration of automation technologies N88-24191
Knowledge based system verification and validation as related to automation of space station subsystems: Rationale for a knowledge based system lifecycle N88-24192
Induction of models under uncertainty
[NASA-TM-101173] N88-24230
Sources and levels of background noise in the NASA Ames 40- by 80-foot wind tunnel
[NASA-TM-100077] N88-24239

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.
Three axis attitude control system
[NASA-CASE-GSC-12970-1] N88-23808
EnviroNET: An interactive space-environment information resource
[NASA-TM-101137] N88-23812
Cellular thermosetting fluoropolymers and process for making them
[NASA-CASE-GSC-13008-1] N88-23894
Non-Newtonian gravity or gravity anomalies?
[NASA-TM-4030] N88-24118
Minimal parameter solution of the orthogonal matrix differential equation
[NASA-TM-4043] N88-24165
Specification for IBM/IBM compatible 3480 tape cartridge
[NASA-TM-100702] N88-24168

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. HUGH L. DRYDEN FLIGHT RESEARCH CENTER, EDWARDS, CALIF.
Augmentor performance of an F100 engine model derivative engine in an F-15 airplane
[NASA-TM-86745] N88-23805

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. HUGH L. DRYDEN FLIGHT RESEARCH FACILITY, EDWARDS, CALIF.
A comparison of experimental and calculated thin-shell leading-edge buckling due to thermal stresses
[NASA-TM-100416] N88-23999
Aerospace energy systems laboratory: Requirements and design approach
[NASA-TM-100423] N88-24206

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. JOHN F. KENNEDY SPACE CENTER, COCOA BEACH, FLA.
Soil erosion and causative factors at Vandenberg Air Force Base, California
[NASA-TM-100981] N88-24156

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TEX.
Locking hinge
[NASA-CASE-MSC-21056-1] N88-23827
Doppler radar with multiphase modulation of transmitted and reflected signal
[NASA-CASE-MSC-18808-1] N88-23923
Hermetically sealable package for hybrid solid-state electronic devices and the like
[NASA-CASE-MSC-20181-1] N88-23941
Pumped two-phase heat transfer loop
[NASA-CASE-MSC-20841-2] N88-23958
Acoustic emission frequency discrimination
[NASA-CASE-MSC-20467-1] N88-23966
Magnetic drive coupling
[NASA-CASE-MSC-21171-1] N88-23973
Interplanetary propulsion using inertial fusion N88-24273
Optimization of organic Rankine cycles for space station applications N88-24407

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, HAMPTON, VA.
Joint University Program for Air Transportation Research, 1986
[NASA-CP-2502] N88-23715
Methodology for matching experimental and computational aerodynamic data
[NASA-TM-100592] N88-23728
High Reynolds number tests of a Douglas DLBA 032 airfoil in the Langley 0.3-meter transonic cryogenic tunnel
[NASA-TM-87663] N88-23734
Numerical simulation of scramjet inlet flow fields
[NASA-TP-2517] N88-23735
Laminar Flow Aircraft Certification
[NASA-CP-2413] N88-23737
High-flaps for natural laminar flow airfoils N88-23739
Computational wing design studies relating to natural laminar flow N88-23740
Wind tunnel testing of low-drag airfoils N88-23741
Boundary layer measurements using hot-film sensors N88-23743
Flight experiences with laminar flow N88-23744
Manufacturing requirements N88-23745
Preliminary aerodynamic design considerations for advanced laminar flow aircraft configurations N88-23746
Operational considerations for laminar flow aircraft N88-23748

Inflow measurement made with a laser velocimeter on a helicopter model in forward flight. Volume 5: Tapered planform blades at an advance ratio of 0.23
[NASA-TM-100545] N88-23755
Unsteady pressure and structural response measurements of an elastic supercritical wing
[NASA-TM-100591] N88-23756
Aeropropulsive characteristics of isolated combined turbojet/ramjet nozzles at Mach numbers from 0 to 1.20
[NASA-TP-2814] N88-23757
Pressure distributions from subsonic tests of an advanced laminar-flow-control wing with leading- and trailing-edge flaps
[NASA-TM-4040-PT-1] N88-23758
Crossflow vorticity sensor
[NASA-CASE-LAR-13436-1-CU] N88-23759
Sensitivity of F-1068 leading-edge-vortex images to flight and vapor-screen parameters
[NASA-TP-2818] N88-23760
Multi-body aircraft with an all-movable center fuselage actively controlling fuselage pressure drag
[NASA-CASE-LAR-13511-1] N88-23765
Sensitivity analysis and multidisciplinary optimization for aircraft design: Recent advances and results
[NASA-TM-100630] N88-23766
Technology development program for twenty-first century aerospace vehicles N88-23768
Control law parameterization for an aeroelastic wind-tunnel model equipped with an active roll control system and comparison with experiment
[NASA-TM-100593] N88-23807
Helicopter anti-torque system using fuselage strakes
[NASA-CASE-LAR-13630-1] N88-23809
Review of convectively cooled structures for hypersonic flight
[NASA-TM-87740] N88-23817
On-orbit technology experiment facility definition
[NASA-TM-100614] N88-23824
LDR structural experiment definition
[NASA-TM-100618] N88-23826
Space spider crane
[NASA-CASE-LAR-13411-1-SB] N88-23828
Strain intensity factor approach for predicting the strength of continuously reinforced metal matrix composites
[NASA-TM-100617] N88-23838
Local buckling and crippling of composite stiffener sections
[NASA-TM-101133] N88-23840
Parameter estimation for boundary value problems by integral equations of the second kind
[NASA-CR-181660] N88-23918
Arc lamp power supply using a voltage multiplier
[NASA-CASE-LAR-13202-1] N88-23942
An efficient parallel algorithm for the simulation of three-dimensional compressible transition on a 20 processor Flex/32 multicomputer
[NASA-CR-178340] N88-23943
Pressure measuring probe
[NASA-CASE-LAR-13853-1] N88-23961
Thermal remote anemometer system
[NASA-CASE-LAR-13508-1] N88-23962
Mining volume measurement system
[NASA-CASE-LAR-13519-1] N88-23963
Bearing-bypass material system test
[NASA-CASE-LAR-13458-1] N88-23967
Composite piston
[NASA-CASE-LAR-13435-1] N88-23981
Variable response load limiting device
[NASA-CASE-LAR-12801-1] N88-23982
Method of radiographic inspection of wooden members
[NASA-CASE-LAR-13724-1] N88-23983
Automatically generated acceptance test: A software reliability experiment
[NASA-CR-181667] N88-23984
Preliminary 2-D shell analysis of the space shuttle solid rocket boosters
[NASA-TM-100515] N88-23989
Mechanics of instability-related delimination growth
[NASA-TM-100622] N88-23996
Structures and Dynamics Division research and technology plans for FY 1988 and accomplishments for FY 1987
[NASA-TM-100585] N88-24000
Application of integrated fluid-thermal-structural analysis methods
[NASA-TM-100625] N88-24001
Three-dimensional models of conventional and vertical junction laser-photovoltaic energy converters
[NASA-TM-4039] N88-24111
Estimation of time- and state-dependent delays and other parameters in functional differential equations
[NASA-CR-181683] N88-24164
Activities of the Institute for Computer Applications in Science and Engineering (ICASE)
[NASA-CR-181666] N88-24166
The Environment for Application Software Integration and Execution (EASIE) version 1.0. Volume 4: System installation and maintenance guide
[NASA-TM-100576] N88-24185
Parallel discrete-event simulation of FCFS stochastic queueing networks
[NASA-CR-181669] N88-24203
Efficient implementation of essentially non-oscillatory shock capturing schemes, 2
[NASA-CR-181656] N88-24217
The exact calculation of quadrupole sources for some incompressible flows
[NASA-TM-100623] N88-24240
An evaluation of energy-independent heavy ion transport coefficient approximations
[NASA-TM-101158] N88-24251
The gamma 1 and gamma 3 bands of (16)O3: Line positions and intensities
[NASA-TM-101162] N88-24541
Line positions and intensities for the gamma 1 + gamma 2 and gamma 2 + gamma 3 bands of (16)O3
[NASA-TM-101161] N88-24542
A benchmark for galactic cosmic ray transport codes
[NASA-TM-101157] N88-24571

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND, OHIO.

In-flight measurement of ice growth on an airfoil using an array of ultrasonic transducers
[AIAA-PAPER-87-0178] N88-23717
A numerical study of the hot gas environment around a STOVL aircraft in ground proximity
[NASA-TM-100895] N88-23729
Saturation and the limit of jet mixing enhancement by single frequency plane wave excitation: Experiment and theory
[NASA-TM-100882] N88-23732
The challenges and opportunities of supersonic transport propulsion technology
[NASA-TM-100921] N88-23806
A cyclic ground test of an ion auxiliary propulsion system: Description and operational considerations
[NASA-TM-100870] N88-23829
Structural Ceramics
[NASA-CP-2427] N88-23872
Ceramics for turbine engines N88-23873
Friction and wear of ceramics N88-23874
Some design considerations for ceramic components in heat engine applications N88-23875
Nondestructive evaluation of structural ceramics N88-23876
Fracture mechanics N88-23877
Strength optimization of alpha-SiC by improved processing N88-23880
Improved processing of Si3N4 N88-23882
Molten salt corrosion of SiC and Si3N4 N88-23885
Ceramic matrix composites N88-23888
Polymer precursors for ceramic composites N88-23890
SiC fiber analysis N88-23891
SiC fiber reinforced reaction-bonded Si3N4 composites N88-23892
Noncontact temperature measurements in the microgravity fluids and transport phenomena discipline N88-23901
Microgravity combustion discipline working group summary of requirements for noncontact temperature measurements N88-23902
Miniature traveling wave tube and method of making
[NASA-CASE-LEW-14520-1] N88-23936
Heat transfer in aerospace propulsion
[NASA-TM-100874] N88-23957
Vibration and control of flexible rotor supported by magnetic bearings
[NASA-TM-100888] N88-23977
Thermal stress minimized, two component, turbine shroud seal
[NASA-CASE-LEW-14212-1] N88-23978
High frequency ultrasonic characterization of sintered SiC
[NASA-TM-100825] N88-23985
Parameter identification methods for improving structural dynamic models
[NASA-TM-100812] N88-23994
Engine structures: A bibliography of Lewis Research Center's research for 1980-1987
[NASA-TM-100842] N88-24002
Overview of NASA Lewis Research Center free-piston Stirling engine technology activities applicable to space power systems N88-24255
Benefits of 20 kHz PMAD in a nuclear space station N88-24256
Speculations on future opportunities to evolve Brayton powerplants aboard the space station N88-24258
Preliminary study of niobium alloy contamination by transport through helium N88-24279
High power ion thruster performance N88-24295
Electric propulsion options for the SP-100 reference mission N88-24296
Analysis of closed cycle megawatt class space power systems with nuclear reactor heat sources N88-24351
Electromagnetic powered vehicles (EMPV) for Mars exploration N88-24388
Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites N88-24427
Status of high power electric propulsion technology N88-24443
Neutron effects on the electrical and switching characteristics of NPN bipolar power transistors N88-24463
Fatigue failure of regenerator screens in a high frequency Stirling engine N88-24491
Space power radiation cooled dc transmission line analysis N88-24506

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.

Moving wall, continuous flow electronphoresis apparatus
[NASA-CASE-MFS-28142-1] N88-23845
Compositional redistribution during casting of Hg sub 0.8 Cd sub 0.2 Te alloys
[NASA-TM-101151] N88-23893
Non-contact temperature measurement requirements for electronic materials processing N88-23898
Non-contact temperature measurements for biotechnology discipline working group N88-23904
Separation of biological materials in microgravity
[NASA-TM-101142] N88-23916
Cylindrical surface profile and diameter measuring tool and method
[NASA-CASE-MFS-28287-1] N88-23959
Dual wavelength holographic interferometry system
[NASA-CASE-MFS-28242-1] N88-23960
Rotor self-lubricating axial stop
[NASA-CASE-MFS-28273-1] N88-23974
Bi-stem gripping apparatus
[NASA-CASE-MFS-28185-1] N88-23979
Welding torch gas cup extension
[NASA-CASE-MFS-29252-1] N88-23980
Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness
[NASA-TP-2697] N88-23988
Effects of natural environment on first generation solid rocket booster thermal protection system materials
[NASA-TM-100329] N88-24113
Centrifugal acceleration of ions in the polar magnetosphere
[NASA-TM-101148] N88-24120
Reconfigurable work station for a video display unit and keyboard
[NASA-CASE-MFS-26009-1-SB] N88-24163
Third Conference on Artificial Intelligence for Space Applications, part 2
[NASA-CP-2492-PT-2] N88-24188
Graphics software tool for VT terminals (VTGRAPH)
[NASA-TM-100331] N88-24201
Description of graphics translation software between Intergraph and Tektronix systems
[NASA-TM-100335] N88-24202
Ion generator and ion application system
[NASA-CASE-MFS-28122-1] N88-24253
Method and apparatus for growing crystals
[NASA-CASE-MFS-28137-1] N88-24544
Liquid encapsulated float zone process and apparatus
[NASA-CASE-MFS-28144-1] N88-24545
Raychaudhuri equation in the self-consistent Einstein-Cartan theory with spin-density
[NASA-TM-101145] N88-24546
Inflation in Einstein-Cartan theory with energy-momentum tensor with spin
[NASA-TM-101164] N88-24547
Consistent transport coefficients in astrophysics
[NASA-TM-101154] N88-24560
Generation of flux tube waves in stellar convection zones. 1: Longitudinal tube waves
[NASA-TM-101152] N88-24561
A model for the X-ray binary 4U1820-30
[NASA-TM-101143] N88-24562
The precipitation of energetic heavy ions into the upper atmosphere of Jupiter
[NASA-TM-101155] N88-24565
The Jovian aurora: Electron or ion precipitation
[NASA-TM-101153] N88-24566

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. PASADENA OFFICE, CALIF.
Method of evaporation
[NASA-CASE-NPO-15609-2] N88-23846
Krypton based adsorption type cryogenic refrigerator
[NASA-CASE-NPO-17334-1-CU] N88-23917
Television monitor field shifter and an opto-electronic method for obtaining a stereo image of optimal depth resolution and reduced depth distrotion on a single screen
[NASA-CASE-NPO-17249-1-CU] N88-23924
Low power consumption current transducer
[NASA-CASE-NPO-16888-1-CU] N88-23937
Cryogenic regenerator including saran-carbon heat conduction matrix
[NASA-CASE-NPO-17291-1-CU] N88-23946
Real time pipelined system for forming the sum of products in the processing of video data
[NASA-CASE-NPO-16462-1-CU] N88-24169
Single mode levitation and translation
[NASA-CASE-NPO-16875-1-CU] N88-24241
Dynamic range compression/expansion of light beams by photorefractive crystals
[NASA-CASE-NPO-17140-1-CU] N88-24508
Method of producing high T(subc) superconducting NBN films
[NASA-CASE-NPO-16681-1-CU] N88-24543

NATIONAL AEROSPACE LAB., AMSTERDAM (NETHERLANDS).
Development of an airborne facility for advanced avionics research N88-23801
A software design tool for the analysis of robot dynamics properties
[NLR-MP-86064-4] N88-24171
Simulation and computer aided engineering (the necessity of an integrated approach)
[NLR-MP-86050-U] N88-24178

NATIONAL BUREAU OF STANDARDS, GAITHERSBURG, MD.
Fast optical pyrometry N88-23908

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D.C.
The NBS scale of radiance temperature N88-23897

NATIONAL PHYSICAL LAB., TEDDINGTON (ENGLAND).
Fitting a circle to radially suppressed data
[NPL-DITC-103/87] N88-24223
Coincidence counting corrections under conditions used by A. DeVolpi
[NPL-RS(EXT)90] N88-24224

NAVAL AIR DEVELOPMENT CENTER, WARMINSTER, PA.
Systems for the 21st century N88-23769
A change in system design emphasis: From machine to man N88-23782
Inadequacies of EMI-seal material: A corrosion study N88-23852

NAVAL POSTGRADUATE SCHOOL, MONTEREY, CALIF.
Interfacing and integrating hardware and software design systems N88-23796
Single phase liquid immersion cooling of discrete heat sources in a vertical channel
[AD-A191224] N88-23944
Unsteady flow about cambered plates
[AD-A191226] N88-23945
Sky radiance distributions for thermal imaging backgrounds
[AD-A191135] N88-24115

NAVAL RESEARCH LAB., WASHINGTON, D.C.
Ion beam alloying of aluminum for corrosion resistance N88-23860
Vanadic hot corrosion of gas turbine blade coating materials N88-23864

NAVAL SURFACE WEAPONS CENTER, SILVER SPRING, MD.
Corrosion of tungsten alloys in marine environments N88-23854
Corrosion and fatique properties of FeCrB/Si metallic glass wires in aqueous environments N88-23855
The effect of titanium reinforcement on the life of positive grids in lead-acid batteries N88-23857

NAVAL WEAPONS CENTER, CHINA LAKE, CALIF.
Microelectronics the next fifteen years N88-23792
Developing systems using state-of-the-art CAD/CAM technology N88-23795

NEBRASKA UNIV., LINCOLN.
Total photoionization cross sections of atomic oxygen from threshold to 44.3A
[NASA-CR-182992] N88-24252

NEW HAMPSHIRE UNIV., DURHAM.
The gamma-ray spectrometer experiment on the solar maximum mission satellite
[NASA-CR-182977] N88-24569

NEW MEXICO STATE UNIV., LAS CRUCES.
Energy optimal trajectory planning for robot manipulators and autonomous vehicles N88-24497

NEW MEXICO UNIV., ALBUQUERQUE.
Transactions of the Fourth Symposium on Space Nuclear Power Systems
[DE88-006164] N88-24254
Space nuclear reactor shielding optimization studies N88-24320
Uranium nitride fuel swelling and thermal conductivity correlations N88-24327
A dynamic model for the aft accumulator in the TE SP-100 system N88-24354
Parametric analyses of the TE SP-100 system performance N88-24358
SP-100 system modeling: SNPSAM update N88-24372
Transactions of the Fifth Symposium on Space Nuclear Power Systems
[DE88-006165] N88-24374
Review of power requirements for satellite remote sensing systems N88-24387
A transient model for liquid metal heat pipes N88-24396
Preliminary analysis of helium generation and its effects on the SP-100 system performance N88-24406
A comparison of uranium nitride and mixed carbide fuels swelling N88-24485
Energy conversion system optimization study for multimegawatt space nuclear power application N88-24492

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA).
A low cost automatic Earth observation satellite tracking ground receiving station N88-23815
Identification of hydroxypropyl starch hydrolysate components N88-23832
Saccharification of cellulose by combined fungal and bacterial preparations N88-23833
Numerical modelling of flows using phoenics N88-23955
A five-layer Open Systems Interconnection (OSI) implementation N88-24204
Interconnection of high-speed local area networks N88-24205
Mahler's method in transcendence theory N88-24227
Interaction of solitons in single model optical fibres N88-24511
The relationship between group process and performance N88-24549

NEW SOUTH WALES UNIV., SYDNEY (AUSTRALIA).
Propulsive performance of a lifting flapping wing N88-23733
Improvements to Raney copper zinc methanol synthesis catalysts N88-23844
Complexation and hydrolysis reactions of iron(III) N88-23867
Modification of polymers by photografting processes N88-23871
Theory of neutron moisture probes and interpretation of measurements in complex soil and water systems N88-23965
Activation, strength and endurance of human respiratory and limb muscles N88-24158
Design considerations for the development of an implantable sensor for the continuous measurement of glucose in the diabetic patient N88-24159
Mathematical modelling of the heat and water vapour transport in the human respiratory tract N88-24160
A new collocation-type method for the numerical solution of Hammerstein equations N88-24226
Novel silicon Schottky barrier infrared imaging arrays N88-24510
The structural analysis of some crystalline and semi-crystalline substances using X-ray and neutron diffraction N88-24540

NORTH CAROLINA STATE UNIV., RALEIGH.
Transient thermohydraulic heat pipe modeling N88-24347

NORTHROP CORP., HAWTHORNE, CALIF.
Managing advanced avionic system design N88-23783

NORTHWESTERN UNIV., EVANSTON, ILL.
The structure and stability of spherically expanding flames N88-23842
Analysis of crack-tip fields in a viscoplastic material N88-23996
Parallel processors and nonlinear structural dynamics algorithms and software
[NASA-CR-182925] N88-24187

NOTRE DAME UNIV., IND.
Error control techniques for satellite and space communications
[NASA-CR-182886] N88-23922

NUCLEAR UTILITY SERVICES, INC., GAITHERSBURG, MD.
Innovative methodology and developments in US space radioisotope power safety risk assessments N88-24362

O

OAK RIDGE NATIONAL LAB., TENN.
High-temperature thermal conductivity of a carbon-bonded carbon-fiber insulation N88-24281
The role of integral experiments and nuclear cross section evaluations in space nuclear reactor design N88-24293
Assessment of energy storage concepts for use in sprint power N88-24312
An experiment to investigate Rankine cycle two-phase microgravity issues N88-24322
A review of diffusion barrier technology for application in SP-100 fuel pins N88-24328
Enhanced emittance of oxidized 304 stainless steel N88-24408
Energy storage for nuclear burst power systems N88-24431
Value assessment of energy storage concepts in burst power systems N88-24432
Review of alkali metal and refractory alloy compatibility for Rankine cycle applications N88-24447
Johnson noise thermometer for high-radiation and high-temperature environments N88-24480
Spectral diagnostics for temperature and density measurements on ATF N88-24525

OAK RIDGE Y-12 PLANT, TENN.
Fabrication of reactor shields at the Y-12 plant N88-24283

OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES, PARIS (FRANCE).
Influence of fiber reinforcement on the vitreous transition temperature of M 10 matrix composites
[ONERA-RT-44/7086-M] N88-23835
Numerical method for unsteady viscous-inviscid interaction to calculate buffeting
[ONERA-RSF-02/3617-AY-008-A] N88-23949
Development and improvement of a code to calculate small, three dimensional, unsteady transonic perturbations
[ONERA-RTS-31/3064-RY-062-R] N88-23951
Accounting for the effects of unsteady, separated boundary layers in transonic two dimensional calculations
[ONERA-RT-30/3084-RY-063-R] N88-23952
Adjusting a finite element model using vibration type experimental data. Concept and error detection
[ONERA-RT-7/3313-RY-060-R] N88-24220
Study of the convergence of a finite difference scheme for acoustic propagation in the atmosphere in a parabolic approximation. Statistical calculation of the sound field in the presence of kinematic turbulence
[ONERA-RS-8/3641-PY-160-P] N88-24235

OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES, TOULOUSE (FRANCE).
Fault diagnosis in orbital refueling operations N88-24154

OHIO STATE UNIV., COLUMBUS.
Manual for obscuration code with space station applications
[NASA-CR-178099] N88-23931

OHIO UNIV., ATHENS.
Investigation of air transportation technology at Ohio University, 1986 N88-23719
Loran-C monitor correlation over a 92-mile baseline in Ohio N88-23720
DATAC bus monitor N88-23721
Integrated multisensor navigation systems N88-23722
Integrated avionics reliability N88-23723

OLD DOMINION UNIV., NORFOLK, VA.
Theoretical studies of solar-pumped lasers
[NASA-CR-182929] N88-23971
Theoretical studies of solar lasers and converters
[NASA-CR-182927] N88-23972

OREGON STATE UNIV., CORVALLIS.
Assessment of nuclear reactor concepts for low power space applications N88-24409
Microgravity thaw experiment (MITEX) N88-24439

ORION INTERNATIONAL TECHNOLOGIES, ALBUQUERQUE, N. MEX.
Space Power Reference Source (SPRS): A user's guide to SDI Space Power Technology Programs N88-24440

OSAKA CITY UNIV. (JAPAN).
Intensity calibration of a VUV system by branching line pairs N88-24533

OXFORD UNIV. (ENGLAND).
Note on the double crystal method of measuring heat transfer coefficient
[OUEL-1710/87] N88-23950
Behavior of a two-layered beam under impact loading
[OUEL-1716/87] N88-23993
Generalized predictive control of multivariable systems
[OUEL-1640/86] N88-24209

An algorithm for super-optimal H sup inf design: The 2-block case
[OUEL-1711/87] N88-24210
A state-space approach to discrete-time super-optimal H sup inf control problems
[OUEL-1712/87] N88-24211

P

PACIFIC NORTHWEST LABS., RICHLAND, WASH.
Design of a high-power-density Ljungstroem turbine using potassium as a working fluid N88-24323
Design of a superconducting alternator for space-based power generation N88-24340
A reflux tube fabric radiator N88-24394
Heat pipe transient analysis: Vapor dynamics N88-24397
Fabric radiators N88-24435
Development of materials for fabric radiators N88-24448
A high power density radial-in-flow reactor split core design for space power systems N88-24455
Reduced-gravity two-phase flow experiments in the NASA KC-135 N88-24465
Analysis and interpretation of low gravity boiling experiments in the KC-135 N88-24466
Molybdenum-base cermet fuel development N88-24481
A combined Rankine/Brayton pulse power cycle N88-24490
PARAIBA UNIV., JOAO PESSOA (BRAZIL).
Indentification of shallow groundwater regions in semi-arid Brazil by remote sensing methods N88-24030
PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
An update on remote measurement of soil moisture over vegetation using infrared temperature measurements: A FIFE perspective
[NASA-CR-182926] N88-24109
On regime selection in global atmospheric flow N88-24119
Finite element simulation of the atmosphere's electromagnetic response to charge perturbations associated with lightning N88-24124
Survival analysis, or what to do with upper limits in astronomical surveys
[NASA-CR-182936] N88-24551
PHYSICAL SCIENCES, INC., ANDOVER, MASS.
Multi-color pyrometer for materials processing in space N88-23905
PITTSBURGH UNIV., PA.
Almost sure L(gamma)-norm convergence for data-based histogram density estimates
[AD-A189944] N88-24229
PRC KENTRON, INC., HAMPTON, VA.
Boundary layer flow visualization for flight testing N88-23742
PRINCETON UNIV., N. J.
Investigation of air transportation technology at Princeton University, 1986 N88-23724
Rule-based fault-tolerant flight control N88-23725
It's time to reinvent the general aviation airplane N88-23726
Flight penetration of wind shear: Control strategies N88-23727
Requirements for temperature and species concentration measurements in microgravity combustion experiments N88-23903
Megawatt level electric propulsion perspectives N88-24294
X-ray emission from tokamaks N88-24514
PURDUE UNIV., WEST LAFAYETTE, IND.
Continuum modeling and dynamic analysis of large truss structures N88-23995
An integrated study of the Alto Paranaiba Kimberlite Province, Minas Gerais, Brazil: A possible tool for diamond exploration N88-24031
State covariance assignment of discrete systems: Development and applications N88-24225

Q

QUANTUM LOGIC CORP., OAKLAND, N.J.
Laser pyrometry N88-23910

R

RANGE COMMANDERS COUNCIL, WHITE SANDS MISSILE RANGE, N. MEX.
Parallel binary and parallel coded decimal time code formats
[AD-A190126] N88-24170
RASOR ASSOCIATES, INC., SUNNYVALE, CALIF.
Advanced thermionic converter technology for inductive output coupling N88-24311
Research and development of electrical insulators for thermionic applications N88-24449
TRICE design, evaluation and feasibility tests N88-24498
RAYMOND (LOUIS) AND ASSOCIATES, NEWPORT BEACH, CALIF.
Hydrogen embrittlement susceptibility of high strength ESR 4340 steel alloys for ballistically resistant/tolerant components N88-23848
RCA ASTRO-ELECTRONICS DIV., PRINCETON, N. J.
Parametric analysis of power requirements for space-based radar N88-24260
RENSSELAER POLYTECHNIC INST., TROY, N.Y.
Noncontact temperature measurement in glass and other transparent materials N88-23900
A timing evaluator for C programs generated by the model system
[AD-A191204] N88-24174
RESEARCH INST. OF NATIONAL DEFENCE, LINKOEPING (SWEDEN).
Notes on artificial intelligence. Part 1: Technical forecast
[FOA-C-30448-3.3-PT-1] N88-24208
RESEARCH INST. OF NATIONAL DEFENCE, STOCKHOLM (SWEDEN).
Terrain classification using SPOT images and the computer system GOP-300
[FOA-C-20677-2.7] N88-24102
Presentation of map information on a color display
[FOA-C-20687-2.7] N88-24103
Simulation: A simulation system in Ada
[FOA-A-20043-2.7] N88-24176
Dialog design: General requirements and analysis of an Ada system
[FOA-C-20691-2.7] N88-24177
RIO GRANDE DO SUL UNIV., PORTO ALEGRE (BRAZIL).
Analysis and interpretation of image lithostructure: An application of the multiconcept in the metamorphic belt of Sul de Santana da Boa Vista (RS) N88-24051
ROCHESTER UNIV., N. Y.
Air Force ultrafast optical electronics center
[AD-A191491] N88-24507
Micro-Raman analysis of dielectric optical thin films
[AD-A191228] N88-24537
ROCKET RESEARCH CORP., REDMOND, WASH.
Arcjet thruster research and technology, phase 1
[NASA-CR-182107] N88-23830
ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CALIF.
SSME technology test bed fast shutdown assessment
[NASA-CR-179354] N88-23831
Fabrication of lithium hydride shields for space nuclear power systems N88-24282
SNAP-DYN: Proven technology for wear-term, higher power in space N88-24422
Energy storage evaluation for burst power applications N88-24430
Trade study for kWe class space reactors N88-24454
Potassium Rankine power system for space power N88-24476
SNAP fuel performance N88-24484
SNAP-DYN: Concepts for multikilowatt space power applications N88-24486
ROCKWELL INTERNATIONAL CORP., LAKEWOOD, CALIF.
Coherent functional development: Key to successful future system integration N88-23803
ROCKWELL INTERNATIONAL CORP., LOS ANGELES, CALIF.
Full potential methods for analysis/design of complex aerospace configurations
[NASA-CR-3982] N88-23736
ROCKWELL INTERNATIONAL CORP., THOUSAND OAKS, CALIF.
AC impedance analysis of corrosion fatigue in naval aircraft alloys
[AD-A190822] N88-23865
ROCKWELL INTERNATIONAL SCIENCE CENTER, THOUSAND OAKS, CALIF.
Stress corrosion cracking properties of Al-Li alloys N88-23853
Development of 20 GHz monolithic transmit modules
[NASA-CR-182134] N88-24539
ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH (ENGLAND).
An assessment of the drag reduction properties of riblets and the penalties of off-design conditions
[RAE-TM-AERO-2113] N88-23731
The prediction of satellite lifetimes
[RAE-TR-87030] N88-23818
GARTEUR TP-037: Impact damage tolerance of carbon fiber and hybrid laminates
[RAE-TR-87057] N88-23837
ROYAL SIGNALS AND RADAR ESTABLISHMENT, MALVERN (ENGLAND).
Experiments in isolated digit recognition using the multilayer perceptron
[RSRE-MEMO-4073] N88-23927
Experimental evaluation of algorithms for connected speech recognition using hidden Markov models
[RSRE-MEMO-4099] N88-23928
Monte Carlo analysis of lateral collection diode arrays
[RSRE-MEMO-4080] N88-23938
Protection and security mechanisms in the SMITE capability computer
[RSRE-MEMO-4117] N88-24167
Development environment for secure software
[RSRE-87015] N88-24179
Separability and security models
[RSRE-87020] N88-24180
Generic cueing in image understanding
[RSRE-MEMO-4109] N88-24181
Linguistic definition of generic models in computer vision
[RSRE-MEMO-4110] N88-24182
RUHR UNIV., BOCHUM (WEST GERMANY).
Availability and quality of spectroscopic data and standards for tokamak studies N88-24534

S

SANDIA NATIONAL LABS., ALBUQUERQUE, N. MEX.
The effect of elevated temperature on irradiated MOS devices N88-24308
The response of a power MOSFET (N-channel) and a dielectric isolated operational amplifier to the combined environmental effects of high temperature and total dose gamma radiation N88-24309
The effect of operating temperature on open, multimegawatt space power systems N88-24352
Comparison of open and closed multimegawatt space power systems N88-24353
RSMASS: A simple model for estimating reactor/shield masses N88-24355
Inherently safe space reactors N88-24363
Hydrogen turbines for space power systems: A simplified axial flow gas turbine model N88-24385
The effect of maximum allowable payload temperature on the mass of a multimegawatt space based platform N88-24416
MACRAD: A mass analysis code for radiators N88-24418
Silicon-on-insulator electronics for a space nuclear power system N88-24461
The response of selected semiconductor technologies to the combined environmental effects of high temperature and total dose gamma radiation N88-24462
The effect of operating temperature and turbine blade cooling on Brayton cycle space power systems N88-24489
Multimegawatt power conditioning requirements study N88-24504
SAO PAULO UNIV. (BRAZIL).
Utilization of TM/LANDSAT images in the implanted forests mapping in the Mogi-Guacu Region (SP-Brazil) N88-24042
Characteristics of drainage determinations in aerial photographs and relief determination on different scales planialtimetric charts for three soils in the state of Sao Paulo N88-24095
SCIENCE AND TECHNOLOGY CORP., HAMPTON, VA.
SAGE 1 and SAM 2 measurements of 1 micron aerosol extinction in the free troposphere
[NASA-CR-182945] N88-24121
SCIENCE APPLICATIONS INTERNATIONAL CORP., ALBUQUERQUE, N. MEX.
Safety constraints and considerations in the development of nuclear powered propulsion N88-24276
Thermal management for multi-modal nuclear power plants N88-24331
SCIENCE APPLICATIONS INTERNATIONAL CORP., CLEARWATER, FLA.
Space reactor end of life issues N88-24413
SCIENCE APPLICATIONS INTERNATIONAL CORP., COLLEGE STATION, TEX.
Sea ice kinematics: Space and time scales
[AD-A191162] N88-24128
Examples of ice pack rigidity and mobility characteristics determined from ice motion
[AD-A191163] N88-24129
SCIENCE APPLICATIONS INTERNATIONAL CORP., MCLEAN, VA.
Soviet spacecraft engineering research
[FASAC-TAR-3090] N88-23823

Soviet remote sensing research and technology
[FASAC-TAR-3130] N88-24108

SCIENCE APPLICATIONS INTERNATIONAL CORP., MONTEREY, CALIF.
An investigation of Soviet capabilities in extended range arctic ice forecasting
[AD-A191082] N88-24127

SCIENCE APPLICATIONS INTERNATIONAL CORP., SCHAUMBERG, ILL.
Applications of nuclear power to lunar and Mars missions N88-24377

SCIENCE SYSTEMS AND APPLICATIONS, INC., GREENBELT, MD.
Research and Technology, 1987, Goddard Space Flight Center N88-24572

SERMATECH INTERNATIONAL, INC., LIMERICK, PA.
Recent advances in metallic/ceramic coatings for corrosion control in military applications N88-23858

SERVICE HYDROGRAPHIQUE ET OCEANOGRAPHIQUE DE LA MARINE, PARIS (FRANCE).
Evaluation of a model of the Earth's gravity field
[EPSHOM-003/87] N88-24116

SERVICE TECHNIQUES DES PROGRAMMES AERONAUTIQUES, PARIS (FRANCE).
Development of complex avionics systems: Experience from French military programs N88-23804

SHEFFIELD UNIV. (ENGLAND).
Existence of periodic solutions in n-dimensional retarded functional differential equations
[RR-325] N88-24221
A recursive prediction error parameter estimator for nonlinear models
[RR-326] N88-24222

SILSOE COLL., BEDFORD (ENGLAND).
A comparison of supervised maximum likelihood and decision tree classification for crop cover estimation from multitemporal LANDSAT MSS data N88-24014
Mapping soil and rock variation from satellite images in the Sahel N88-24023
Satellite remote sensing of turbidity and sediment concentration in Lagoa dos Patos N88-24032

SIRA INST. LTD., CHISLEHURST (ENGLAND).
Botany Facility pre-phase C/D. Core payload for EURECA, volume 2
[BF-RP-ER-015-VOL-2] N88-24130
Botany Facility: Breadboarding results of the illumination system
[SIRA-A/7373/WP110/MAC003] N88-24137
Botany Facility: Magnetic fluid seal considerations for the centrifuge
[SIRA-A/7373/WP110/MAC004] N88-24138
Botany Facility: Considerations and analyses of the balancing system philosophy proposed for the BF centrifuge
[SIRA-A/7373/WP110/PWF001] N88-24139
Botany Facility: The problems of plant fixation
[SIRA-A/7373/WP220/RJS/001] N88-24140
Botany Facility: Problems of water supply, plant nutrients and soil in the Botany Facility
[SIRA-A/7373/WP220/RJS/003] N88-24141
Supply and distribution of plant nutrients in the Botany Facility
[SIRA-A/7373/WP220/RJS/004] N88-24142
EURECA Botany Facility. Technical note: Removal of phytotoxins
[SIRA-A/7373/WP220/RJS/005] N88-24143
Botany Facility pre-phase C/D. Core payload for EURECA, volume 1
[BF-RP-ER-015-VOL-1] N88-24144

SMITHSONIAN ASTROPHYSICAL OBSERVATORY, CAMBRIDGE, MASS.
Balloon-borne three-meter telescope for far-infrared and submillimeter astronomy
[NASA-CR-182924] N88-24550

SOCIEDAD COLOMBIANA DE FOTOGRAMETRIA Y PERCEPCION REMOTA, BOGOTA.
The use of SLAR and SIRA imagenes for the classification of forest typen in tropical rain forests N88-24036

SOCIEDAD DE ESPECIALISTAS LATINOAMERICANOS EN PERCEPTION REMOTA (CHILE).
Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, volume 1 N88-24013

SOCIEDADE BRASILEIRA DE CARTOGRAFIA, GEODESIA, FOTOGRAMTRIA E SENSORIAMENTO REMOTO.
Latin American Symposium on Remote Sensing. 4th Brazilian Remote Sensing Symposium and 6th SELPER Plenary Meeting, volume 1 N88-24013

SOCIETE ANONYME DE TELECOMMUNICATIONS, PARIS (FRANCE).
Study for the determination of general and specific properties of wide energy-band gap HgCdTe in the 1 to 2 micrometer wavelength range
[AD-A191091] N88-23934

SOCIETE EUROPEENNE DE PROPULSION, BORDEAUX (FRANCE).
The geometric workstation, a new approach for geometric corrections of remotely sensed data N88-24017

SOCIETE NATIONALE INDUSTRIELLE AEROSPATIALE, MARIGNANE (FRANCE).
Design and development of an avionics system adapted to helicopter missions N88-23786

SOUTHAMPTON UNIV. (ENGLAND).
The calculation of casually constrained optima in the active control of sound
[ISVR-TR-147] N88-24237

SPACE POWER, INC., SAN JOSE, CALIF.
Gigawatt, closed cycle, vapor core-MHD space power system conceptual design study N88-24473

STANFORD UNIV., CALIF.
Improved estimators in simultaneous estimation of scale parameters
[AD-A191108] N88-24216
On Hotelling's approach to testing for a nonlinear parameter in regression
[AD-A191189] N88-24229

STATE DEPT., WASHINGTON, D. C.
Discussions and agreements in the United Nations on important issues associated with nuclear power in space N88-24411

STATE UNIV. OF NEW YORK, BUFFALO.
Clinical applications of computerized thermography N88-23915

STUTTGART UNIV. (WEST GERMANY).
Preparation and execution of calibration measurements for handling of airborne SAR data (AGRISAR)
[ETN-88-92338] N88-23926

SUNDSTRAND CORP., ROCKFORD, ILL.
Two-phase fluid management for a Rankine cycle isotope power system N88-24303
Status of the organic Rankine cycle for space applications N88-24402
Experimental demonstrations of organic Rankine cycle waste heat rejection systems N88-24469

SUPERIOR ELECTRIC CO., BRISTOL, CONN.
Angular position measurements at high temperatures and high radiation environments N88-24479

SVERDRUP TECHNOLOGY, INC., CLEVELAND, OHIO.
The Lewis heat pipe code with application to SP-100 GES heat pipes N88-24395

SYSTEMS CONTROL TECHNOLOGY, INC., ARLINGTON, VA.
Analyses of heliport system plans
[DOT/FAA/PM-87/31] N88-23810

SYSTEMS DESIGNERS LTD., CAMBERLEY (ENGLAND).
Solid Earth mission end-to-end data system study
[C04825.08/FR] N88-23811

T

TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS).
Asymptotics for a system of nonlinearly coupled wave equations with an application to the galloping oscillations of overhead transmission lines
[REPT-87-78] N88-23991
Coupling of satellite remote sensing to digitized topographic map to detect changes in land use
[B8735129] N88-24104
Adjustment in photogrammetry: Methods, programs and applications
[B8735130] N88-24105
Digital monoplotting, part 1
[B8735122-PT-1] N88-24106
Digital monoplotting, part 2
[B8735122-PT-2] N88-24107
The determination of gravity and topography from seismic velocities, accounting for dynamic behavior of the Earth's mantle
[ETN-88-92420] N88-24117
Refraction in underwater acoustics
[B8735053] N88-24236

TECHNOLOGICAL MARKETING ANALYSIS CORP., SAN FRANCISCO, CALIF.
Subsurface morphology and geoarchaeology revealed by spaceborne and airborne radar N88-24022

TEXAS A&M UNIV., COLLEGE STATION.
A fusion based plasma propulsion system N88-24274
Fully passive space reactor conceptual design N88-24288
Nuclear electric propulsion system: Nuclear plant and thermomechanical conversion system N88-24298
Cermet fuel thermal conductivity N88-24329
A thermal equilibrium model for multi-megawatt space platforms N88-24332
Radiation effects testing capabilities of the Texas A and M Nuclear Science Center N88-24368
EETAP (End-to-End Transient Analysis Program) for space nuclear power system simulation N88-24381
Possible creep studies of lithium with a compact device N88-24404
An irradiation performance data base for nitride fuels N88-24438
Microgravity two-phase fluid flow pattern modeling N88-24467
Material property and irradiation performance correlations for nitride fuels N88-24483
An optimal disturbance rejection control system for multimegawatt space nuclear power systems N88-24495

TEXAS TECHNOLOGICAL UNIV., LUBBOCK.
Relating design and environmental variables to reliability N88-24383

TEXTRON BELL HELICOPTER, FORT WORTH, TEX.
Development and testing of a predictive methodology for optimization of man-machine interface in future avionics systems N88-23780

THEMAG EGENHARIA LTDA., SAO PAULO (BRAZIL).
Utilization of LANDSAT-TM imagery in the hydroenergetic inventory of the Paraiba de Sul River Basin N88-24077

THERMACORE, INC., LANCASTER, PA.
A capillary pumped SHE/AMTEC system N88-24500

THOMSON-CSF, MALAKOFF (FRANCE).
Architecture and role of the Sensor Subsystem in future aircraft weapon systems N88-23770

THORN EMI, HAYES (ENGLAND).
The integration, characterisation and trialling of a modern complex airborne radar N88-23791

TOKYO UNIV. (JAPAN).
Distorted-wave-method calculation of electron-impact excitation of atomic ions N88-24532

TOLEDO UNIV., OHIO.
Transient analysis of Li and LiH thermal storage spheres N88-24334

TOULOUSE UNIV. (FRANCE).
The Systeme d'Analyse Geographique (SAGE) geographic analysis system N88-24019
The SAGE geographic analysis system N88-24063

TRW DEFENSE AND SPACE SYSTEMS GROUP, REDONDO BEACH, CALIF.
Candidate advanced energy storage concepts for multimegawatt burst power systems N88-24434

TRW SPACE TECHNOLOGY LABS., REDONDO BEACH, CALIF.
A generalized method for optimizing the mass of space power systems N88-24369

TSUKUBA UNIV. (JAPAN).
Hot electron diagnostics using X-ray imaging on GAMMA10 N88-24530

U

UNITED NATIONS, NEW YORK, N. Y.
The USSR space systems for remote sensing of earth resources and the environment (sensor systems, processing techniques, applications) N88-24035

UNITED TECHNOLOGIES CORP., SOUTH WINDSOR, CONN.
High power density alkaline fuel cell technology for MMW space burst power N88-24451

UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CONN.
Laser Diagnostics for combustion temperature and species measurements N88-23912
The effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Part 4: Aerodynamic data tabulation
[NASA-CR-179469] N88-23956

UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO, MEXICO CITY.
Spatial filtering on digital images N88-24025

UNIVERSIDAD NACIONAL DE LUJAN (ARGENTINA).
Estimation of an area cultivated with wheat from LANDSAT data through a two-phase sampling method N88-24041

UNIVERSIDAD NACIONAL DE SAN JUAN (ARGENTINA).
Dune fields in central Western Argentina N88-24088
The breaked anticlines, cuesta and crest homoclines, ortoclinal valleys, and other forms of relief outcrops delineated with the help of remote sensing imagery N88-24089
Geomorphologic sector maps of Niquizanga-Mayares, province of San Juan, Argentina N88-24098

UNIVERSIDADE ESTADUAL DE PAULISTA, GUARATINGUETA (BRAZIL).
Implantation of a geo-cartographical information system through microcomputers N88-24064
Current stage of remote sensing system for cartographic application N88-24090

UNIVERSIDADE FEDERAL DE PARANA, CURITIBA (BRAZIL).
The 35 mm vertical aerial photographs for mapping stands of bracatinga in different age classes N88-24087
Stereoscopic photographs, ground and aerial, of trees used in the arborization of Curitiba (PR) N88-24091
UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.
Observations of frontal instabilities on an upwelling filament [AD-A191051] N88-24122

V

VANZETTI SYSTEMS, INC., STOUGHTON, MASS.
The role of fiberoptics in remote temperature measurement N88-23909
VIBRATION INST., CLARENDON HILLS, ILL.
The Shock and Vibration Digest, volume 20, no. 4 N88-24214
VIGYAN RESEARCH ASSOCIATES, INC., HAMPTON, VA.
Natural laminar flow and airplane stability and control N88-23747
VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
The LDCM actuator for vibration suppression [NASA-CR-182898] N88-23940
Fiber waveguide sensors for intelligent materials [NASA-CR-183028] N88-23968
VIRGINIA STATE UNIV., PETERSBURG.
Materials science with muon spin rotation [NASA-CR-182891] N88-24242

W

WALES UNIV. INST. OF SCIENCE AND TECHNOLOGY, CARDIFF.
Preparation of improved PbSnTe thermoelectric alloys and evaluation of their figure of merit [AD-A191346] N88-24538
WASHINGTON UNIV., SEATTLE.
Structural ceramics research N88-23878
Fractographic and microstructural evaluation of 3500-hour durability specimens N88-23887
Multimegawatt nuclear power system for lunar base applications N88-24367
Colliding stellar winds in the eclipsing Wolf-Rayet binary V444 Cygni [NASA-CR-182937] N88-24563
WESTINGHOUSE ELECTRIC CORP., MADISON, PA.
The Curie point radiator N88-24420
The NERVA derivative reactor and a systematic approach to multiple space power requirements N88-24458
Alkali metal thermoelectric converter design for space power systems applications N88-24499
WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.
A critique of NERVA based nuclear reactor design and performance for MMW space propulsion applications N88-24297
Development of reliable fuel pins for space reactor applications N88-24326
Fabrication of a niobium 1 percent zirconium containment for SP-100 primary lithium system materials mass transfer studies N88-24373
A nuclear powered space based multimegawatt MHD diec power system N88-24471
WESTINGHOUSE ELECTRIC CORP., SUNNYVALE, CALIF.
Rotating-hoop, pulsed-energy converter N88-24433
WESTINGHOUSE HANFORD CO., RICHLAND, WASH.
Selection of a handling and maintenance option for the SP-100 ground engineering system test N88-24285
SP-100 GES test site N88-24375
Development of refractory thermocouples for space nuclear power tests N88-24478
SP-100 ground engineering systems test facility control systems N88-24496
WISCONSIN UNIV., MADISON.
Radiation thermometry: The measurement problem N88-23896
Noncontact temperature measurement: Requirements and applications for metals and alloys research N88-23899
Magnet shielding analysis for SOAR: A space fusion reactor N88-24269
Helium-3 fusion fuel resources for space power N88-24330
SOAR: Space orbiting advanced fusion power reactor N88-24366
Energy requirements for HE-3 mining operations on the Moon N88-24390
Critical issues for SOAR: The space orbiting advanced fusion power reactor N88-24474

Y

YALE UNIV., NEW HAVEN, CONN.
Control of combustion and acoustically coupled fluid dynamic instabilities N88-23843
On the efficient implementation of the fast multipole algorithm [AD-A191167] N88-24173
Differential spectral synthesis of the stellar populations in the bulges of spiral galaxies N88-24558

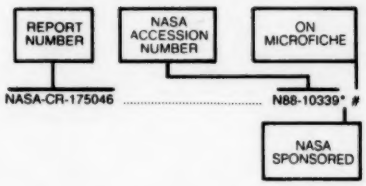
Typical Contract Number Index Listing

Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.

A-85-76-301 ..... N88-24116
AF PROJ. 2304 ..... N88-24228
AF-AFOSR-0158-84 ..... N88-24175
AF-AFOSR-0221-85 ..... N88-24537
AF-AFOSR-00138-84 ..... N88-23920
AT(04-3)-701 ..... N88-24484
AT(11-1)-GEN-8 ..... N88-24282
AT(29-2)-2831 ..... N88-24300
DA PROJ. R02202 ..... N88-23865
DA PROJ. 1L1-61103-BH-57 ..... N88-24538
DAAG29-85-K-0049 ..... N88-23920
N88-23921
DAAG29-85-K-0210 ..... N88-23920
DAJA45-86-C-0032 ..... N88-24538
DAJA45-87-C-0020 ..... N88-23934
DASG60-85-C-0076 ..... N88-24314
DE-AC01-83NE-32114 ..... N88-24362
DE-AC02-76CH-00016 ..... N88-24243
N88-24244
N88-24245
N88-24246
N88-24247
N88-24248
N88-24266
N88-24267
N88-24386
DE-AC02-76CH-03000 ..... N88-24555
DE-AC02-78ER-04940 ..... N88-23920
DE-AC02-83CE-40651 ..... N88-24325
N88-24502
DE-AC02-86NE-37960 ..... N88-24438
N88-24483
DE-AC02-86NE-37962 ..... N88-24494
DE-AC03-84ER-51044 ..... N88-24519
DE-AC03-85SF-15928 ..... N88-24331
DE-AC03-85SF-15936 ..... N88-24420
DE-AC03-86SF-16006 ..... N88-24315
N88-24459
N88-24460
DE-AC03-86SF-16298 ..... N88-24449
DE-AC03-86SF-16503 ..... N88-24499
DE-AC03-86SF-16508 ..... N88-24492
DE-AC03-87SF-17169 ..... N88-24449
DE-AC04-75DP-00789 ..... N88-24309
N88-24462
DE-AC04-76DP-00789 ..... N88-24278
N88-24308
N88-24352
N88-24353
N88-24355
N88-24363
N88-24385
N88-24416
N88-24418
N88-24461
N88-24489
N88-24504
DE-AC05-84OR-21400 ..... N88-24281
N88-24283
N88-24328
N88-24349
N88-24408
N88-24432
N88-24447
DE-AC06-76FF-02170 ..... N88-24284
N88-24285
DE-AC06-76RL-01830 ..... N88-24323
N88-24340
N88-24394
N88-24448
N88-24455
N88-24481
N88-24490
DE-AC06-87RL-10930 ..... N88-24375
N88-24478
N88-24496
DE-AC07-76ID-01570 ..... N88-24277
N88-24344
N88-24348
N88-24357
N88-24365
N88-24379
N88-24436
N88-24482
DE-AC09-76SR-00001 ..... N88-24429
DE-AC22-87PC-79665 ..... N88-24471
DE-AC07-76ID-01570 ..... N88-24287
DEN3-27 ..... N88-23886
DNA001-85-C-0184 ..... N88-24383
DNA001-85-C-0320 ..... N88-24473
DRET-84-34-115-00-470-75-01 ..... N88-23870
DRET-84-147 ..... N88-23970
DRET-85-34-001 ..... N88-23835
DRET-85-34-341-00-470-75-01 ..... N88-24238
DRET-86-34-001 ..... N88-24220
DRET-86-001 ..... N88-24235
DRET-86-003/05 ..... N88-23730
DRET-86-1367 ..... N88-23836
DTFA01-87-C-00014 ..... N88-23810
DTRS-57-83-C-00097 ..... N88-23720
EEC-85-B6602-11-010-11-N N88-24112
ESA-6415/85-NL-PR N88-24130
N88-24144
ESTEC-6591/86-NL-JS N88-23811
EX-76-C-16-3066 ..... N88-24300
F04611-85-C-004 ..... N88-24294
F04611-86-C-0111 ..... N88-24415
F04701-85-C-0086 ..... N88-23868
N88-23869
N88-23935
F04701-85-C-0086-P00019 ..... N88-23812
F04701-85-C-0090 ..... N88-24421
F19628-86-C-0001 ..... N88-24184
F27601-86-C-0214 ..... N88-24434
F29601-84-C-0080 ..... N88-24372
N88-24398
F29601-85-C-0060 ..... N88-24440
F29601-86-C-0238 ..... N88-24261
F30602-85-C-0072 ..... N88-23920
F33615-85-C-2544 ..... N88-24321
F33615-86-R-5009 ..... N88-23862
F49620-85-C-0008 ..... N88-24228
F49620-85-C-0013 ..... N88-24334
F49620-85-C-0067 ..... N88-23920
F49620-85-C-0210 ..... N88-23920
N88-23921
F49620-86-C-0039 ..... N88-23819
F49620-87-C-0016 ..... N88-24507
F129601-74-C-0080 ..... N88-24358
JPL-954997 ..... N88-24294
JPL-956473 ..... N88-24265
N88-24306
N88-24315
N88-24356
JPL-956969 ..... N88-24262
LANL-9-X6D-1878G-1 ..... N88-24483
LANL-9-X6D-1879G-1 ..... N88-24483
MIPR-FR-1455-85-N0632 ..... N88-24312
MIPR-FY-1455-85-N0617 ..... N88-24312
MIPR-FY-1455-86-N0615 ..... N88-24312
NAGW-509 ..... N88-24550
NAG1-148 ..... N88-24111
NAG1-270 ..... N88-24217
NAG1-343 ..... N88-23840
NAG1-416 ..... N88-24242
NAG1-537 ..... N88-23840
NAG1-613 ..... N88-24199
NAG1-650 ..... N88-24187
NAG1-719 ..... N88-23940
NAG1-757 ..... N88-23972
NAG1-780 ..... N88-23968
NAG2-100 ..... N88-24157
NAG3-328 ..... N88-23986
N88-23987
NAG3-436 ..... N88-23899
NAG3-468 ..... N88-23883
NAG3-589 ..... N88-24464
NAG3-605 ..... N88-24316
NAG3-633 ..... N88-24464
NAG3-666 ..... N88-23717
N88-23718
NAG3-752 ..... N88-24409
NAG5-526 ..... N88-23841
NAG5-537 ..... N88-24563
NAG5-557 ..... N88-23922
NAG5-720 ..... N88-24569
NAG5-898 ..... N88-24123
NAG5-919 ..... N88-24109
NAG8-555 ..... N88-24551
NAG9-211 ..... N88-24213
NAG9-219 ..... N88-23929
NASA ORDER W-16215 ..... N88-24112
NASW-4191 ..... N88-24387
NASW-4292 ..... N88-24155
NAS1-15325 ..... N88-23763
NAS1-15820 ..... N88-23736
NAS1-16856 ..... N88-23839
NAS1-17670 ..... N88-23738
NAS1-17797 ..... N88-23747
NAS1-18020 ..... N88-24233
NAS1-18032 ..... N88-24172
NAS1-18107 ..... N88-23918
N88-23943
N88-23984
N88-24164
N88-24166
N88-24203
N88-24217
NAS3-23247 ..... N88-24539
NAS3-23708 ..... N88-23751
N88-23752
N88-23753
NAS3-23717 ..... N88-23956
NAS3-23894 ..... N88-23939
NAS3-24384 ..... N88-23879
NAS3-24631 ..... N88-23830
NAS5-28769 ..... N88-24126
NAS7-918 ..... N88-23917
N88-23919
N88-23924
N88-23932
N88-23933
N88-23937
N88-23946
N88-24012
N88-24110
N88-24508
NAS8-20228 ..... N88-24464
NAS8-35184 ..... N88-24162
NAS8-35594 ..... N88-24121
NAS8-40000 ..... N88-23831
NAS9-15800 ..... N88-24198
NAS10-10285 ..... N88-24156
NCC1-80 ..... N88-24542
NGL-17-004-024 ..... N88-24101
NGL-22-009-640 ..... N88-23717
N88-23718
NGR-23-005-015 ..... N88-24566
NGR-28-004-021 ..... N88-24252
NGT-21-002-823 ..... N88-23825
NIVR-427-02305N N88-24171
NSF CBT-83-52345 ..... N88-24289
NSF CPE-83-17878 ..... N88-24305
NSF DMR-85-03223 ..... N88-24243
N88-24244
N88-24245
N88-24246

N88-24247
NSF DMR-85-04719 ..... N88-24317
NSF DMS-86-02335 ..... N88-24229
NSF INT-84-13978 ..... N88-24245
N88-24246
NSF PHY-85-09880-05 ..... N88-24248
NSG-1498 ..... N88-23931
NSG-1568 ..... N88-23971
NSG-5123 ..... N88-24200
N00014-78-C-0154 ..... N88-23920
N00014-78-C-0517 ..... N88-23920
N00014-85-C-0763 ..... N88-24127
N00014-86-K-0158 ..... N88-24216
N00014-86-K-0310 ..... N88-24173
N00014-86-K-0442 ..... N88-24174
N00014-86-K-0694 ..... N88-23920
N00014-87-C-0173 ..... N88-24128
N88-24129
N00014-87-K-0078 ..... N88-24229
N00014-87-K-0220 ..... N88-24122
N62269-85-C-0218 ..... N88-23851
N62269-85-R-0248 ..... N88-23865
ORNL-IIX-02207V N88-24476
SERC-GR/D/30587 ..... N88-24222
STPA-85-95-004 ..... N88-23952
STPA-85-95-009 ..... N88-23951
STPA-88-95-009 ..... N88-23949
W-31-109-ENG-38 ..... N88-24263
N88-24264
N88-24286
N88-24304
N88-24313
N88-24391
N88-24453
N88-24457
N88-24535
W-32-109-ENG-38 ..... N88-24423
N88-24456
N88-24493
W-7405-ENG-36 ..... N88-24231
N88-24346
N88-24449
W-7405-ENG-38 ..... N88-24273
W-7405-ENG-48 ..... N88-24190
N88-24350
N88-24570
147-23-11-70 ..... N88-24542
147-51-02 ..... N88-24012
199-22-75-01 ..... N88-24251
N88-24571
307-50-06-03 ..... N88-23758
314-40-31-30-21 ..... N88-23919
480-51-13-01 ..... N88-23826
482-52-21-01 ..... N88-24148
482-54-23-15 ..... N88-23931
505-31-03-02 ..... N88-23735
505-31-21 ..... N88-23750
505-45-63-06 ..... N88-23763
505-61-01-02 ..... N88-23734
505-61-11 ..... N88-24239
505-61-41-02 ..... N88-23737
505-61-51-10 ..... N88-23755
505-61-71-03 ..... N88-23760
505-61-71-05 ..... N88-23736
505-62-21 ..... N88-23729
N88-23732
N88-23957
505-62-91 ..... N88-23751
N88-23752
N88-23753
505-62-91-01 ..... N88-23757
505-63-1B N88-23977
N88-23994
505-63-01-05 ..... N88-23996
505-63-11 ..... N88-23766
505-63-21-04 ..... N88-23726
N88-23756
N88-23807
505-63-51 ..... N88-24240
505-66-01-50 ..... N88-23715
505-66-41 ..... N88-23762
505-90-21-01 ..... N88-23918
N88-23943
N88-23984
N88-24164
N88-24166
N88-24203
N88-24217
506-41-41-01 ..... N88-24111
506-42-31 ..... N88-24295
N88-24296
506-43-11 ..... N88-23986
N88-23987
506-43-11-04 ..... N88-23838
506-43-41-02 ..... N88-24000
506-43-41-04 ..... N88-23989
506-43-81 ..... N88-23999
506-44-21 ..... N88-24539
506-46-11-01 ..... N88-24172
506-48-22 ..... N88-23829
506-49-11-05 ..... N88-23817
506-49-31-01 ..... N88-23824
N88-24185
506-49-31-03 ..... N88-23824
506-63-1B N88-24002
533-02-21 ..... N88-23805
533-04-11 ..... N88-23956
533-05-01 ..... N88-23872
533-07-01 ..... N88-23985
534-06-13-01 ..... N88-23839
535-03-11-03 ..... N88-24233
650-60-15-01 ..... N88-23933
992-23-05 ..... N88-24206

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The NASA accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-85414 ..... N88-23750* #
A-87163-VOL-1 ..... N88-24145* #
A-87247-VOL-4 ..... N88-24148* #
A-88112 ..... N88-24239* #
A-88139 ..... N88-23762* #

AD-A189660 ..... N88-23847 #
AD-A189944 ..... N88-24228 #
AD-A190126 ..... N88-24170 #
AD-A190198 ..... N88-23920 #
AD-A190199 ..... N88-23921 #
AD-A190822 ..... N88-23865 #
AD-A191051 ..... N88-24122 #
AD-A191056 ..... N88-23868 #
AD-A191057 ..... N88-23869 #
AD-A191082 ..... N88-24127 #
AD-A191091 ..... N88-23934 #
AD-A191108 ..... N88-24216 #
AD-A191135 ..... N88-24115 #
AD-A191150 ..... N88-23935 #
AD-A191162 ..... N88-24128 #
AD-A191163 ..... N88-24129 #
AD-A191167 ..... N88-24173 #
AD-A191189 ..... N88-24229 #
AD-A191204 ..... N88-24174 #
AD-A191224 ..... N88-23944 #
AD-A191226 ..... N88-23945 #
AD-A191228 ..... N88-24537 #
AD-A191235 ..... N88-23819 #
AD-A191239 ..... N88-24175 #
AD-A191346 ..... N88-24538 #
AD-A191491 ..... N88-24507 #
AD-A192036 ..... N88-24182 #

AD-E500916 ..... N88-24115 #
AD-E801612 ..... N88-23944 #
AD-E801612 ..... N88-23945 #

AERONOMICA-ACTA-A-322-1987 ..... N88-24112* #

AFOSR-87-1767TR ..... N88-24175 #
AFOSR-87-1843TR ..... N88-24228 #
AFOSR-88-0024TR ..... N88-24507 #
AFOSR-88-0160TR ..... N88-24537 #
AFOSR-88-0278TR ..... N88-23819 #

AFWAL-TR-87-4139-VOL-2 ..... N88-23847 #

AGARD-CP-417 ..... N88-23767 #

AIAA-PAPER-86-1352 ..... N88-23718* #
AIAA-PAPER-87-0178 ..... N88-23717* #
AIAA-PAPER-88-2211 ..... N88-23807* #
AIAA-PAPER-88-2277 ..... N88-23756* #

AIAA-88-2392 ..... N88-23728* #
AIAA-88-2985 ..... N88-23806* #

ANL-HEP-CP-87-124 ..... N88-24535 #

AVSCOM-TM-88-B-008-VOL-5 ..... N88-23755* #

BF-RP-ER-015-VOL-1 ..... N88-24144 #
BF-RP-ER-015-VOL-2 ..... N88-24130 #

BF-TN-ER-053 ..... N88-24136 #
BF-TN-ER-061/88 ..... N88-24135 #

BR103730 ..... N88-23818 #
BR104811 ..... N88-23938 #
BR104812 ..... N88-24179 #
BR104824 ..... N88-23731 #
BR104949 ..... N88-23837 #
BR104990 ..... N88-24167 #
BR104991 ..... N88-23928 #
BR105251 ..... N88-24180 #
BR105252 ..... N88-23927 #
BR105253 ..... N88-24182 #
BR105255 ..... N88-24181 #

B8733101 ..... N88-24171 #
B8733102 ..... N88-24178 #
B8735053 ..... N88-24236 #
B8735122-PT-1 ..... N88-24106 #
B8735122-PT-2 ..... N88-24107 #
B8735129 ..... N88-24104 #
B8735130 ..... N88-24105 #
B8736948 ..... N88-23991 #

CAA-1/87 ..... N88-23761

CAP-526 ..... N88-23761

CCMS-88-08 ..... N88-23840* #

CEAT-39/M/79-C-M1-641300 ..... N88-23834 #

CNES-88/CT/DRT/TVE/IL/25 ..... N88-23816 #

CONF-870102-SUMMS ..... N88-24254 #
CONF-871245-5 ..... N88-24570 #
CONF-880122-SUMMS ..... N88-24374 #
CONF-8710218-3 ..... N88-24535 #

C04825.08/FR ..... N88-23811 #

DE87-703010 ..... N88-24536 #
DE88-005951 ..... N88-24535 #
DE88-006164 ..... N88-24254 #
DE88-006165 ..... N88-24374 #
DE88-006991 ..... N88-24555 #
DE88-007024 ..... N88-24231 #
DE88-007027 ..... N88-24570 #
DE88-701140 ..... N88-24114 #

DF/NH-3616/84 ..... N88-23866 #

DOE/CS-66001/11 ..... N88-24110* #

DOT/FAA/PM-87/31 ..... N88-23810 #

DOT/FAA/PP-88/1 ..... N88-23810 #

D6-52151 ..... N88-23763* #

E-3063 ..... N88-23872* #
E-3251 ..... N88-23829* #
E-3994 ..... N88-23994* #
E-3995 ..... N88-23987* #
E-4001 ..... N88-23751* #
E-4002 ..... N88-23752* #
E-4003 ..... N88-23753* #
E-4013 ..... N88-23985* #
E-4033 ..... N88-24002* #
E-4043 ..... N88-23986* #
E-4105 ..... N88-23957* #
E-4115 ..... N88-23732* #
E-4123 ..... N88-23977* #
E-4138 ..... N88-23729* #
E-4178 ..... N88-23806* #

ENST-87E021 ..... N88-23925 #

EPSHOM-003/87 ..... N88-24116 #

ESA-CR(P)-2508 ..... N88-23811 #
ESA-CR(P)-2510-VOL-1 ..... N88-24144 #
ESA-CR(P)-2510-VOL-2 ..... N88-24130 #

ESA-PSS-03-1201-ISSUE-1 ..... N88-23821 #
ESA-PSS-03-1202-ISSUE-1 ..... N88-23822 #

ESA-SP-1092 ..... N88-24554 #
ESA-SP-1095 ..... N88-23814 #

ESA-STR-225 ..... N88-24183 #

ETN-88-91925 ..... N88-23947 #
ETN-88-91926 ..... N88-24249 #
ETN-88-91929 ..... N88-23990 #
ETN-88-91949 ..... N88-23813 #
ETN-88-91958 ..... N88-24144 #
ETN-88-91959 ..... N88-24130 #
ETN-88-92046 ..... N88-23818 #
ETN-88-92160 ..... N88-24116 #
ETN-88-92161 ..... N88-23834 #
ETN-88-92166 ..... N88-23835
ETN-88-92168 ..... N88-23870 #
ETN-88-92170 ..... N88-24207 #
ETN-88-92180 ..... N88-23925 #
ETN-88-92194 ..... N88-24218 #
ETN-88-92195 ..... N88-23948 #
ETN-88-92200 ..... N88-24176 #
ETN-88-92201 ..... N88-24102 #
ETN-88-92202 ..... N88-24103 #
ETN-88-92203 ..... N88-24177 #
ETN-88-92204 ..... N88-24206 #
ETN-88-92222 ..... N88-24178 #
ETN-88-92224 ..... N88-24171 #
ETN-88-92276 ..... N88-23964 #
ETN-88-92277 ..... N88-24219 #
ETN-88-92293 ..... N88-24220 #
ETN-88-92294 ..... N88-23949 #
ETN-88-92295 ..... N88-24235 #
ETN-88-92298 ..... N88-23866 #
ETN-88-92299 ..... N88-23836 #
ETN-88-92301 ..... N88-23730 #
ETN-88-92303 ..... N88-24250 #
ETN-88-92304 ..... N88-24509 #
ETN-88-92308 ..... N88-23969 #
ETN-88-92334 ..... N88-23820 #
ETN-88-92338 ..... N88-23926 #
ETN-88-92347 ..... N88-24232 #
ETN-88-92418 ..... N88-24104 #
ETN-88-92419 ..... N88-24105 #
ETN-88-92420 ..... N88-24117 #
ETN-88-92421 ..... N88-24106 #
ETN-88-92422 ..... N88-24107 #
ETN-88-92453 ..... N88-23991 #
ETN-88-92471 ..... N88-24236 #
ETN-88-92484 ..... N88-24112* #
ETN-88-92501 ..... N88-24556 #
ETN-88-92502 ..... N88-24237 #
ETN-88-92503 ..... N88-23761
ETN-88-92509 ..... N88-23837 #
ETN-88-92510 ..... N88-23731 #
ETN-88-92511 ..... N88-23992 #
ETN-88-92512 ..... N88-24179 #
ETN-88-92513 ..... N88-24180 #
ETN-88-92514 ..... N88-23927 #
ETN-88-92515 ..... N88-23938 #
ETN-88-92517 ..... N88-23928 #
ETN-88-92518 ..... N88-24181 #
ETN-88-92519 ..... N88-24182 #
ETN-88-92520 ..... N88-24167 #
ETN-88-92524 ..... N88-24221 #
ETN-88-92525 ..... N88-24222 #
ETN-88-92528 ..... N88-24223
ETN-88-92529 ..... N88-24224
ETN-88-92530 ..... N88-24209 #
ETN-88-92531 ..... N88-23950 #
ETN-88-92532 ..... N88-24210 #
ETN-88-92533 ..... N88-24211 #
ETN-88-92534 ..... N88-23993 #
ETN-88-92541 ..... N88-23970 #
ETN-88-92542 ..... N88-24238 #
ETN-88-92544 ..... N88-23951 #
ETN-88-92545 ..... N88-23952 #

ETN-88-92548 ..... N88-23821 #
ETN-88-92549 ..... N88-23822 #
ETN-88-92553 ..... N88-23811 #
ETN-88-92554 ..... N88-24183 #
ETN-88-92556 ..... N88-24554 #
ETN-88-92557 ..... N88-23814 #
ETN-88-92563 ..... N88-23816 #

FAA-AC-36-4B ..... N88-24234 #

FASAC-TAR-3090 ..... N88-23823 #
FASAC-TAR-3130 ..... N88-24106 #

FNAL/PUB-88/19-A ..... N88-24555 #

FOA-A-20043-2.7 ..... N88-24176 #

FOA-C-20677-2.7 ..... N88-24102 #
FOA-C-20687-2.7 ..... N88-24103 #
FOA-C-20691-2.7 ..... N88-24177 #
FOA-C-30448-3.3-PT-1 ..... N88-24208 #

GAO/NSIAD-88-122 ..... N88-23764 #

H-1309 ..... N88-23805* #
H-1440 ..... N88-23999* #
H-1448 ..... N88-24206* #

IC-AERO-87-02 ..... N88-23992 #

ICASE-87-41 ..... N88-23943* #
ICASE-88-24 ..... N88-24217* #
ICASE-88-25 ..... N88-24164* #
ICASE-88-28 ..... N88-23918* #
ICASE-88-29 ..... N88-24203* #
ICASE-88-31 ..... N88-23984* #

IPPJ-861 ..... N88-24512 #

IR-71 ..... N88-23840* #

IRIG-STANDARD-205-77 ..... N88-24170 #
IRIG-STANDARD-205-87 ..... N88-24170 #

ISAL-IDI1-87-15 ..... N88-23948 #

ISBN-0-86-039302-X N88-23761
ISBN-92-835-0437-2 ..... N86-23767 #

ISSN-0065-3713 ..... N88-24112* #
ISSN-0069-5882 ..... N88-24232 #
ISSN-0143-7135 ..... N88-24224
ISSN-0262-5369 ..... N88-24223
ISSN-0308-7247 ..... N88-23992 #
ISSN-0343-7639 ..... N88-23990 #
ISSN-0347-3694 ..... N88-24102 #
ISSN-0347-3694 ..... N88-24103 #
ISSN-0347-3694 ..... N88-24177 #
ISSN-0347-3708 ..... N88-24208 #
ISSN-0348-4580 ..... N88-24176 #
ISSN-0379-4059 ..... N88-23821 #
ISSN-0379-4059 ..... N88-23822 #
ISSN-0379-4067 ..... N88-24183 #
ISSN-0379-6566 ..... N88-24554 #
ISSN-0388-9653 ..... N88-24003 #
ISSN-0436-1199 ..... N88-23947 #
ISSN-0436-1199 ..... N88-24249 #
ISSN-0469-4732 ..... N88-24512 #
ISSN-0751-1353 ..... N88-23925 #
ISSN-0920-8577 ..... N88-23991 #
ISSN-0951-6301 ..... N88-23761

ISVR-TR-147 ..... N88-24237 #

JINR-18-86-708 ..... N88-24114 #

JPL-PUBL-87-4 ..... N88-23919* #
JPL-PUBL-87-41 ..... N88-24012* #
JPL-PUBL-88-2 ..... N88-23932* #
JPL-PUBL-88-8 ..... N88-24110* #
JPL-PUBL-88-12 ..... N88-23933* #

JPL-17140 ..... N88-24508* #

JSC-22603 ..... N88-24184* #

JUEL-SPEZ-399 ..... N88-23990 #

KIYI-86-27 ..... N88-24536 #

L-16000 ..... N88-23735* #
L-16083 ..... N88-23734* #
L-16111 ..... N88-23737* #
L-16390 ..... N88-23757* #
L-16395 ..... N88-23760* #
L-16405 ..... N88-23758* #
L-16406 ..... N88-23715* #
L-16424 ..... N88-24111* #

LA-11225-MS ..... N88-24231 #

LAAS-87-354 ..... N88-24207 #

LC-87-28154 ..... N88-24564* #

LG86ER0022-PT-1 ..... N88-23751* #
LG86ER0022-PT-2 ..... N88-23752* #
LG86ER0022-PT-3 ..... N88-23753* #

M-576-PT-2 ..... N88-24188* #

MCR-86-542 ..... N88-24162* #

MITT-54 ..... N88-24232 #

MPIS-2/1987 ..... N88-23947 #
MPIS-3/1987 ..... N88-24249 #

MSAT-X-REPT-148 ..... N88-23933* #

MTR-10028 ..... N88-24184* #

M4-487000 ..... N88-23866 #
M4-494300 ..... N88-23866 #

NADC-87183-60 ..... N88-23865 #

NAS 1.15:4030 ..... N88-24118* #
NAS 1.15:4039 ..... N88-24111* #
NAS 1.15:4040-PT-1 ..... N88-23758* #
NAS 1.15:4043 ..... N88-24165* #
NAS 1.15:86745 ..... N88-23805* #
NAS 1.15:86838 ..... N88-23750* #
NAS 1.15:87663 ..... N88-23734* #
NAS 1.15:87740 ..... N88-23817* #
NAS 1.15:100077 ..... N88-24239* #
NAS 1.15:100329 ..... N88-24113* #
NAS 1.15:100331 ..... N88-24201* #
NAS 1.15:100335 ..... N88-24202* #
NAS 1.15:100416 ..... N88-23999* #
NAS 1.15:100423 ..... N88-24206* #
NAS 1.15:100515 ..... N88-23989* #
NAS 1.15:100545 ..... N88-23755* #
NAS 1.15:100576 ..... N88-24185* #
NAS 1.15:100585 ..... N88-24000* #
NAS 1.15:100591 ..... N88-23756* #
NAS 1.15:100592 ..... N88-23728* #
NAS 1.15:100593 ..... N88-23807* #
NAS 1.15:100614 ..... N88-23824* #
NAS 1.15:100617 ..... N88-23838* #
NAS 1.15:100618 ..... N88-23826* #
NAS 1.15:100622 ..... N88-23998* #
NAS 1.15:100623 ..... N88-24240* #
NAS 1.15:100625 ..... N88-24001* #
NAS 1.15:100630 ..... N88-23766* #
NAS 1.15:100702 ..... N88-24168* #
NAS 1.15:100812 ..... N88-23994* #
NAS 1.15:100825 ..... N88-23985* #
NAS 1.15:100842 ..... N88-24002* #
NAS 1.15:100870 ..... N88-23829* #
NAS 1.15:100874 ..... N88-23957* #
NAS 1.15:100882 ..... N88-23732* #
NAS 1.15:100888 ..... N88-23977* #
NAS 1.15:100895 ..... N88-23729* #
NAS 1.15:100921 ..... N88-23806* #
NAS 1.15:100981 ..... N88-24156* #
NAS 1.15:100996 ..... N88-23762* #
NAS 1.15:101133 ..... N88-23840* #
NAS 1.15:101137 ..... N88-23812* #
NAS 1.15:101142 ..... N88-23916* #
NAS 1.15:101143 ..... N88-24562* #
NAS 1.15:101145 ..... N88-24546* #
NAS 1.15:101148 ..... N88-24120* #
NAS 1.15:101151 ..... N88-23893* #
NAS 1.15:101152 ..... N88-24561* #
NAS 1.15:101153 ..... N88-24566* #
NAS 1.15:101154 ..... N88-24560* #
NAS 1.15:101155 ..... N88-24565* #
NAS 1.15:101157 ..... N88-24571* #
NAS 1.15:101158 ..... N88-24251* #
NAS 1.15:101161 ..... N88-24542* #
NAS 1.15:101162 ..... N88-24541* #
NAS 1.15:101164 ..... N88-24547* #
NAS 1.15:101165 ..... N88-24199* #
NAS 1.15:101173 ..... N88-24230* #
NAS 1.21:493 ..... N88-24564* #
NAS 1.21:7011(311) N88-24161*
NAS 1.21:7069 ..... N88-24553* #
NAS 1.26:3875 ..... N88-23839* #
NAS 1.26:3880 ..... N88-23763* #
NAS 1.26:3922(20) N88-24155*
NAS 1.26:3982 ..... N88-23736* #
NAS 1.26:4129-PT-1 ..... N88-23751* #
NAS 1.26:4129-PT-2 ..... N88-23752* #
NAS 1.26:4129-PT-3 ..... N88-23753* #
NAS 1.26:4136 ..... N88-24233* #
NAS 1.26:4151 ..... N88-23987* #
NAS 1.26:4153 ..... N88-23986* #
NAS 1.26:4156 ..... N88-24172* #
NAS 1.26:175071 ..... N88-23939* #
NAS 1.26:178099 ..... N88-23931* #
NAS 1.26:178340 ..... N88-23943* #
NAS 1.26:178930 ..... N88-24162* #
NAS 1.26:179354 ..... N88-23831* #
NAS 1.26:179469 ..... N88-23956* #
NAS 1.26:180780 ..... N88-23825* #
NAS 1.26:181656 ..... N88-24217* #
NAS 1.26:181660 ..... N88-23918* #
NAS 1.26:181663 ..... N88-24164* #
NAS 1.26:181666 ..... N88-24166* #
NAS 1.26:181667 ..... N88-23984* #
NAS 1.26:181669 ..... N88-24203* #
NAS 1.26:182107 ..... N88-23830* #
NAS 1.26:182134 ..... N88-24539* #
NAS 1.26:182799 ..... N88-24101* #
NAS 1.26:182802 ..... N88-24126* #
NAS 1.26:182848 ..... N88-24157* #
NAS 1.26:182871 ..... N88-23841* #
NAS 1.26:182886 ..... N88-23922* #
NAS 1.26:182887 ..... N88-24213* #
NAS 1.26:182891 ..... N88-24242* #
NAS 1.26:182893 ..... N88-24184* #
NAS 1.26:182898 ..... N88-23940* #
NAS 1.26:182906 ..... N88-24123* #
NAS 1.26:182908 ..... N88-23929* #
NAS 1.26:182917 ..... N88-24110* #
NAS 1.26:182919 ..... N88-24012* #
NAS 1.26:182921 ..... N88-23933* #
NAS 1.26:182922 ..... N88-23919* #
NAS 1.26:182923 ..... N88-23932* #
NAS 1.26:182924 ..... N88-24550* #
NAS 1.26:182925 ..... N88-24187* #
NAS 1.26:182926 ..... N88-24109* #
NAS 1.26:182927 ..... N88-23972* #
NAS 1.26:182929 ..... N88-23971* #
NAS 1.26:182936 ..... N88-24551* #
NAS 1.26:182937 ..... N88-24563* #
NAS 1.26:182945 ..... N88-24121* #
NAS 1.26:182949 ..... N88-24198* #
NAS 1.26:182953 ..... N88-24200* #
NAS 1.26:182965 ..... N88-24112* #
NAS 1.26:182977 ..... N88-24569* #
NAS 1.26:182992 ..... N88-24252* #
NAS 1.26:183028 ..... N88-23968* #
NAS 1.55:2413 ..... N88-23737* #
NAS 1.55:2426-VOL-1 ..... N88-24145* #
NAS 1.55:2426-VOL-4 ..... N88-24148* #
NAS 1.55:2427 ..... N88-23872* #
NAS 1.55:2492-PT-2 ..... N88-24188* #
NAS 1.55:2502 ..... N88-23715* #
NAS 1.55:2503 ..... N88-23895* #
NAS 1.60:2517 ..... N88-23735* #
NAS 1.60:2697 ..... N88-23988* #
NAS 1.60:2814 ..... N88-23757* #
NAS 1.60:2818 ..... N88-23760* #
NAS 1.71:LAR-13508-1 ..... N88-23962* #
NAS 1.71:LAR-13519-1 ..... N88-23963* #
NAS 1.71:LAR-13724-1 ..... N88-23983* #
NAS 1.71:LAR-13853-1 ..... N88-23961* #
NAS 1.71:LEW-14520-1 ..... N88-23936* #
NAS 1.71:MFS-28242-1 ..... N88-23960* #
NAS 1.71:MFS-28273-1 ..... N88-23974* #
NAS 1.71:MFS-28287-1 ..... N88-23959* #
NAS 1.71:MSC-18808-1 ..... N88-23923* #
NAS 1.71:MSC-21171-1 ..... N88-23973* #
NAS 1.71:NPO-16888-1-CU ..... N88-23937* #
NAS 1.71:NPO-17140-1-CU ..... N88-24508* #
NAS 1.71:NPO-17249-1-CU ..... N88-23924* #
NAS 1.71:NPO-17291-1-CU ..... N88-23946* #
NAS 1.71:NPO-17334-1-CU ..... N88-23917* #

NASA-CASE-GSC-12970-1 ..... N88-23808*
NASA-CASE-GSC-13008-1 ..... N88-23894*

NASA-CASE-LAR-12801-1 ..... N88-23982*
NASA-CASE-LAR-13202-1 ..... N88-23942*
NASA-CASE-LAR-13411-1-SB N88-23828*
NASA-CASE-LAR-13435-1 ..... N88-23981*
NASA-CASE-LAR-13436-1-CU N88-23759*
NASA-CASE-LAR-13458-1 ..... N88-23967*
NASA-CASE-LAR-13508-1 ..... N88-23962* #
NASA-CASE-LAR-13511-1 ..... N88-23765*
NASA-CASE-LAR-13519-1 ..... N88-23963* #
NASA-CASE-LAR-13630-1 ..... N88-23809*
NASA-CASE-LAR-13724-1 ..... N88-23983* #
NASA-CASE-LAR-13853-1 ..... N88-23961* #

NASA-CASE-LEW-14212-1 ..... N88-23978*

NASA-CASE-LEW-14520-1 ..... N88-23936* #

NASA-CASE-MFS-26009-1-SB N88-24163*
NASA-CASE-MFS-28122-1 ..... N88-24253*
NASA-CASE-MFS-28137-1 ..... N88-24544*
NASA-CASE-MFS-28142-1 ..... N88-23845*
NASA-CASE-MFS-28144-1 ..... N88-24545*
NASA-CASE-MFS-28185-1 ..... N88-23979*
NASA-CASE-MFS-28242-1 ..... N88-23960* #
NASA-CASE-MFS-28273-1 ..... N88-23974* #
NASA-CASE-MFS-28287-1 ..... N88-23959* #
NASA-CASE-MFS-29252-1 ..... N88-23980*

NASA-CASE-MSC-18808-1 ..... N88-23923* #
NASA-CASE-MSC-20181-1 ..... N88-23941*
NASA-CASE-MSC-20467-1 ..... N88-23966*
NASA-CASE-MSC-20841-2 ..... N88-23958*
NASA-CASE-MSC-21056-1 ..... N88-23827*
NASA-CASE-MSC-21171-1 ..... N88-23973* #

NASA-CASE-NPO-15609-2 ..... N88-23846*
NASA-CASE-NPO-16462-1-CU N88-24169*
NASA-CASE-NPO-16675-1-CU N88-24241*
NASA-CASE-NPO-16681-1-CU N88-24543*
NASA-CASE-NPO-16888-1-CU ..... N88-23937* #
NASA-CASE-NPO-17140-1-CU ..... N88-24508* #
NASA-CASE-NPO-17249-1-CU ..... N88-23924* #
NASA-CASE-NPO-17291-1-CU ..... N88-23946* #
NASA-CASE-NPO-17334-1-CU ..... N88-23917* #

NASA-CP-2413 ..... N88-23737* #
NASA-CP-2426-VOL-1 ..... N88-24145* #
NASA-CP-2426-VOL-4 ..... N88-24148* #
NASA-CP-2427 ..... N88-23872* #
NASA-CP-2492-PT-2 ..... N88-24188* #
NASA-CP-2502 ..... N88-23715* #
NASA-CP-2503 ..... N88-23895* #

NASA-CR-3875 ..... N88-23839* #
NASA-CR-3880 ..... N88-23763* #
NASA-CR-3922(20) N88-24155*
NASA-CR-3982 ..... N88-23736* #
NASA-CR-4129-PT-1 ..... N88-23751* #
NASA-CR-4129-PT-2 ..... N88-23752* #
NASA-CR-4129-PT-3 ..... N88-23753* #
NASA-CR-4136 ..... N88-24233* #
NASA-CR-4151 ..... N88-23987* #
NASA-CR-4153 ..... N88-23986* #
NASA-CR-4156 ..... N88-24172* #
NASA-CR-175071 ..... N88-23939* #
NASA-CR-178099 ..... N88-23931* #
NASA-CR-178340 ..... N88-23943* #
NASA-CR-178930 ..... N88-24162* #
NASA-CR-179354 ..... N88-23831* #
NASA-CR-179469 ..... N88-23956* #
NASA-CR-180780 ..... N88-23825* #
NASA-CR-181656 ..... N88-24217* #
NASA-CR-181660 ..... N88-23918* #
NASA-CR-181663 ..... N88-24164* #
NASA-CR-181666 ..... N88-24166* #
NASA-CR-181667 ..... N88-23984* #
NASA-CR-181669 ..... N88-24203* #
NASA-CR-182107 ..... N88-23830* #
NASA-CR-182134 ..... N88-24539* #
NASA-CR-182799 ..... N88-24101* #
NASA-CR-182802 ..... N88-24126* #
NASA-CR-182848 ..... N88-24157* #
NASA-CR-182871 ..... N88-23841* #
NASA-CR-182886 ..... N88-23922* #
NASA-CR-182887 ..... N88-24213* #
NASA-CR-182891 ..... N88-24242* #
NASA-CR-182893 ..... N88-24184* #
NASA-CR-182898 ..... N88-23940* #
NASA-CR-182906 ..... N88-24123* #
NASA-CR-182908 ..... N88-23929* #
NASA-CR-182917 ..... N88-24110* #
NASA-CR-182919 ..... N88-24012* #
NASA-CR-182921 ..... N88-23933* #
NASA-CR-182922 ..... N88-23919* #
NASA-CR-182923 ..... N88-23932* #
NASA-CR-182924 ..... N88-24550* #
NASA-CR-182925 ..... N88-24187* #
NASA-CR-182926 ..... N88-24109* #
NASA-CR-182927 ..... N88-23972* #
NASA-CR-182929 ..... N88-23971* #
NASA-CR-182936 ..... N88-24551* #
NASA-CR-182937 ..... N88-24563* #
NASA-CR-182945 ..... N88-24121* #
NASA-CR-182949 ..... N88-24198* #
NASA-CR-182953 ..... N88-24200* #
NASA-CR-182965 ..... N88-24112* #
NASA-CR-182977 ..... N88-24569* #
NASA-CR-182992 ..... N88-24252* #
NASA-CR-183028 ..... N88-23968* #

NASA-SP-493 ..... N88-24564* #

NASA-SP-7011(311) N88-24161*
NASA-SP-7069 ..... N88-24553* #

NASA-TM-4030 ..... N88-24118* #
NASA-TM-4039 ..... N88-24111* #
NASA-TM-4040-PT-1 ..... N88-23758* #
NASA-TM-4043 ..... N88-24165* #
NASA-TM-86745 ..... N88-23805* #
NASA-TM-86838 ..... N88-23750* #
NASA-TM-87663 ..... N88-23734* #
NASA-TM-87740 ..... N88-23817* #
NASA-TM-100077 ..... N88-24239* #
NASA-TM-100329 ..... N88-24113* #
NASA-TM-100331 ..... N88-24201* #
NASA-TM-100335 ..... N88-24202* #
NASA-TM-100416 ..... N88-23999* #
NASA-TM-100423 ..... N88-24206* #
NASA-TM-100515 ..... N88-23989* #
NASA-TM-100545 ..... N88-23755* #
NASA-TM-100576 ..... N88-24185* #
NASA-TM-100585 ..... N88-24000* #
NASA-TM-100591 ..... N88-23756* #
NASA-TM-100592 ..... N88-23728* #
NASA-TM-100593 ..... N88-23807* #
NASA-TM-100614 ..... N88-23824* #
NASA-TM-100617 ..... N88-23838* #
NASA-TM-100618 ..... N88-23826* #
NASA-TM-100622 ..... N88-23998* #
NASA-TM-100623 ..... N88-24240* #
NASA-TM-100625 ..... N88-24001* #
NASA-TM-100630 ..... N88-23766* #
NASA-TM-100702 ..... N88-24168* #
NASA-TM-100812 ..... N88-23994* #
NASA-TM-100825 ..... N88-23985* #
NASA-TM-100842 ..... N88-24002* #
NASA-TM-100870 ..... N88-23829* #
NASA-TM-100874 ..... N88-23957* #
NASA-TM-100882 ..... N88-23732* #
NASA-TM-100888 ..... N88-23977* #
NASA-TM-100895 ..... N88-23729* #
NASA-TM-100921 ..... N88-23806* #
NASA-TM-100981 ..... N88-24156* #
NASA-TM-100996 ..... N88-23762* #
NASA-TM-101133 ..... N88-23840* #
NASA-TM-101137 ..... N88-23812* #
NASA-TM-101142 ..... N88-23916* #
NASA-TM-101143 ..... N88-24562* #
NASA-TM-101145 ..... N88-24546* #
NASA-TM-101148 ..... N88-24120* #
NASA-TM-101151 ..... N88-23893* #
NASA-TM-101152 ..... N88-24561* #
NASA-TM-101153 ..... N88-24566* #
NASA-TM-101154 ..... N88-24560* #
NASA-TM-101155 ..... N88-24565* #
NASA-TM-101157 ..... N88-24571* #
NASA-TM-101158 ..... N88-24251* #
NASA-TM-101161 ..... N88-24542* #
NASA-TM-101162 ..... N88-24541* #
NASA-TM-101164 ..... N88-24547* #
NASA-TM-101165 ..... N88-24199* #
NASA-TM-101173 ..... N88-24230* #

NASA-TP-2517 ..... N88-23735* #
NASA-TP-2697 ..... N88-23988* #
NASA-TP-2814 ..... N88-23757* #
NASA-TP-2818 ..... N88-23760* #

NLR-MP-86050-U ..... N88-24178 #
NLR-MP-86064-4 ..... N88-24171 #

NPL-DITC-103/87 ..... N88-24223

NPL-RS(EXT)90 ..... N88-24224

NPS69-87-012 ..... N88-23945 #

ONERA-RS-8/3641-PY-160-P ..... N88-24235 #

ONERA-RSF-02/3617-AY-008-A ..... N88-23949 #

ONERA-RT-7/3313-RY-060-R ..... N88-24220 #
ONERA-RT-30/3064-RY-063-R ..... N88-23952 #
ONERA-RT-44/7086-M N88-23835

ONERA-RTS-31/3064-RY-062-R ..... N88-23951 #

OUEL-1640/86 ..... N88-24209 #
OUEL-1710/87 ..... N88-23950 #
OUEL-1711/87 ..... N88-24210 #
OUEL-1712/87 ..... N88-24211 #
OUEL-1716/87 ..... N88-23993 #

PTR-88-5 ..... N88-23971* #

RAE-MAT/STR-206 ..... N88-23837 #

RAE-SS-1 ..... N88-23818 #

RAE-TM-AERO-2113 ..... N88-23731 #

RAE-TR-87030 ..... N88-23818 #
RAE-TR-87057 ..... N88-23837 #

REPT-46/87 ..... N88-23813 #
REPT-76-20 ..... N88-23839* #
REPT-87-R-1175 ..... N88-23830* #
REPT-87-78 ..... N88-23991 #
REPT-87/43 ..... N88-23730 #
REPT-88B0104 ..... N88-24118* #
REPT-88B0106 ..... N88-24165* #
REPT-88B0181 ..... N88-24168* #
REPT-191/86 ..... N88-24157* #
REPT-5542-6A2 ..... N88-23810 #
REPT-716199-7 ..... N88-23931* #

RPI-TR-87-29 ..... N88-24174 #

RR-325 ..... N88-24221 #
RR-326 ..... N88-24222 #
RR-641-I-IMAG-39-LIFIA ..... N88-23964 #
RR-642-I-IMAG-53-LIFIA ..... N88-24219 #

RSRE-MEMO-4073 ..... N88-23927 #
RSRE-MEMO-4080 ..... N88-23938 #
RSRE-MEMO-4099 ..... N88-23928 #
RSRE-MEMO-4109 ..... N88-24181 #
RSRE-MEMO-4110 ..... N88-24182 #
RSRE-MEMO-4117 ..... N88-24167 #

RSRE-87015 ..... N88-24179 #
RSRE-87020 ..... N88-24180 #

RSS-8788 ..... N88-23831* #

SAIC-87/1869 ..... N88-24129 #
SAIC-87/1870 ..... N88-24128 #

SC5436.2FR ..... N88-23865 #
SC5492.FR ..... N88-24539* #

SD-TR-87-60 ..... N88-23868 #
SD-TR-88-14 ..... N88-23869 #
SD-TR-88-29 ..... N88-23935 #
SD-TR-88-60 ..... N88-23812* #

SER-C-PREPUBL-FASC-20 ..... N88-24556 #

SIRA-A/7373/WP110/MAC003 ..... N88-24137 #
SIRA-A/7373/WP110/MAC004 ..... N88-24138 #
SIRA-A/7373/WP110/PWF001 ..... N88-24139 #
SIRA-A/7373/WP220/RJS/001 ..... N88-24140 #
SIRA-A/7373/WP220/RJS/003 ..... N88-24141 #
SIRA-A/7373/WP220/RJS/004 ..... N88-24142 #
SIRA-A/7373/WP220/RJS/005 ..... N88-24143 #

TB-RB524-002/87 ..... N88-24133 #

TD(88)1 ..... N88-23814 #

TN-RB524-006/87 ..... N88-24132 #
TN-RB524-097/86 ..... N88-24134 #
TN-RB524-107/86 ..... N88-24131 #

TR-6 ..... N88-24229 #
TR-87-30 ..... N88-24226 #
TR-88-18 ..... N88-23929* #
TR-399 ..... N88-24216 #
TR-0086(6728-01)-1 ..... N88-23868 #
TR-0086A(2945-03)-4 ..... N88-23869 #
TR-0088(3671-01)-1 ..... N88-23812* #

U-1541-349-PT-1 ..... N88-24233* #

UCRL-98226 ..... N88-24570 #

UMAERO-88-5 ..... N88-23825* #

US-PATENT-APPL-SN-003676 ..... N88-23759*
US-PATENT-APPL-SN-008895 ..... N88-23809*
US-PATENT-APPL-SN-013801 ..... N88-23765*
US-PATENT-APPL-SN-013902 ..... N88-23967*
US-PATENT-APPL-SN-021100 ..... N88-24253*
US-PATENT-APPL-SN-032679 ..... N88-23958*
US-PATENT-APPL-SN-044181 ..... N88-23980*
US-PATENT-APPL-SN-056930 ..... N88-23979*
US-PATENT-APPL-SN-122740 ..... N88-23959* #
US-PATENT-APPL-SN-125021 ..... N88-24508* #
US-PATENT-APPL-SN-125686 ..... N88-23924* #
US-PATENT-APPL-SN-125678 ..... N88-23983* #
US-PATENT-APPL-SN-130058 ..... N88-23936* #
US-PATENT-APPL-SN-133412 ..... N88-23937* #
US-PATENT-APPL-SN-135120 ..... N88-23973* #

US-PATENT-APPL-SN-143436 ..... N88-23961* #
US-PATENT-APPL-SN-146936 ..... N88-23963* #
US-PATENT-APPL-SN-146939 ..... N88-23962* #
US-PATENT-APPL-SN-149821 ..... N88-23917* #
US-PATENT-APPL-SN-149822 ..... N88-23960* #
US-PATENT-APPL-SN-149830 ..... N88-23974* #
US-PATENT-APPL-SN-309291 ..... N88-23982*
US-PATENT-APPL-SN-392093 ..... N88-23941*
US-PATENT-APPL-SN-511363 ..... N88-23846*
US-PATENT-APPL-SN-627537 ..... N88-24241*
US-PATENT-APPL-SN-755288 ..... N88-23958*
US-PATENT-APPL-SN-761310 ..... N88-23846*
US-PATENT-APPL-SN-764812 ..... N88-24543*
US-PATENT-APPL-SN-789266 ..... N88-24241*
US-PATENT-APPL-SN-795805 ..... N88-23808*
US-PATENT-APPL-SN-805011 ..... N88-24163*
US-PATENT-APPL-SN-815106 ..... N88-24169*
US-PATENT-APPL-SN-867987 ..... N88-23894*
US-PATENT-APPL-SN-874319 ..... N88-23966*
US-PATENT-APPL-SN-875796 ..... N88-23978*
US-PATENT-APPL-SN-879758 ..... N88-23942*
US-PATENT-APPL-SN-890583 ..... N88-23981*
US-PATENT-APPL-SN-904126 ..... N88-23845*
US-PATENT-APPL-SN-913432 ..... N88-23828*
US-PATENT-APPL-SN-924399 ..... N88-24545*
US-PATENT-APPL-SN-925189 ..... N88-24544*
US-PATENT-APPL-SN-934397 ..... N88-23827*

US-PATENT-CLASS-16-292 ..... N88-23827*
US-PATENT-CLASS-16-297 ..... N88-23827*
US-PATENT-CLASS-16-326 ..... N88-23827*
US-PATENT-CLASS-16-332 ..... N88-23827*
US-PATENT-CLASS-16-345 ..... N88-23827*
US-PATENT-CLASS-16-347 ..... N88-23827*
US-PATENT-CLASS-16-349 ..... N88-23827*
US-PATENT-CLASS-73-147 ..... N88-23759*
US-PATENT-CLASS-73-178-R N88-23759*
US-PATENT-CLASS-73-505 ..... N88-24241*
US-PATENT-CLASS-73-587 ..... N88-23966*
US-PATENT-CLASS-73-794 ..... N88-23967*
US-PATENT-CLASS-73-801 ..... N88-23966*
US-PATENT-CLASS-73-810 ..... N88-23967*
US-PATENT-CLASS-92-176 ..... N88-23981*
US-PATENT-CLASS-92-212 ..... N88-23981*
US-PATENT-CLASS-92-214 ..... N88-23981*
US-PATENT-CLASS-92-222 ..... N88-23981*
US-PATENT-CLASS-92-224 ..... N88-23981*
US-PATENT-CLASS-108-3 ..... N88-24163*
US-PATENT-CLASS-108-7 ..... N88-24163*
US-PATENT-CLASS-123-193-P N88-23981*
US-PATENT-CLASS-126-423 ..... N88-23958*
US-PATENT-CLASS-156-DIG.70 ..... N88-24544*
US-PATENT-CLASS-156-DIG.70 ..... N88-24545*
US-PATENT-CLASS-156-DIG.72 ..... N88-24544*
US-PATENT-CLASS-156-DIG.72 ..... N88-24545*
US-PATENT-CLASS-156-DIG.82 ..... N88-24544*
US-PATENT-CLASS-156-DIG.82 ..... N88-24545*
US-PATENT-CLASS-156-DIG.84 ..... N88-24545*
US-PATENT-CLASS-156-DIG.89 ..... N88-24545*
US-PATENT-CLASS-156-DIG.92 ..... N88-24545*
US-PATENT-CLASS-156-607 ..... N88-24544*
US-PATENT-CLASS-156-620.76 ..... N88-24545*
US-PATENT-CLASS-156-621 ..... N88-24544*
US-PATENT-CLASS-156-624 ..... N88-24544*
US-PATENT-CLASS-159-3 ..... N88-23846*
US-PATENT-CLASS-159-48.2 ..... N88-23846*
US-PATENT-CLASS-159-900 ..... N88-23846*
US-PATENT-CLASS-165-1 ..... N88-23958*
US-PATENT-CLASS-165-13 ..... N88-23958*
US-PATENT-CLASS-165-41 ..... N88-23958*
US-PATENT-CLASS-165-104.14 ..... N88-23958*
US-PATENT-CLASS-174-52-PE N88-23941*
US-PATENT-CLASS-174-52-R N88-23941*
US-PATENT-CLASS-174-52-S N88-23941*
US-PATENT-CLASS-180-8.6 ..... N88-23828*
US-PATENT-CLASS-181-0.5 ..... N88-24241*
US-PATENT-CLASS-188-373 ..... N88-23982*
US-PATENT-CLASS-203-90 ..... N88-23846*
US-PATENT-CLASS-203-91 ..... N88-23846*
US-PATENT-CLASS-203-98 ..... N88-23846*
US-PATENT-CLASS-204-160.1 ..... N88-23845*
US-PATENT-CLASS-204-192.15 ..... N88-24543*
US-PATENT-CLASS-204-192.24 ..... N88-24543*
US-PATENT-CLASS-204-299-R N88-23845*
US-PATENT-CLASS-219-75 ..... N88-23980*
US-PATENT-CLASS-219-137.42 ..... N88-23980*
US-PATENT-CLASS-244-15 ..... N88-23765*
US-PATENT-CLASS-244-17.19 ..... N88-23809*
US-PATENT-CLASS-244-91 ..... N88-23809*
US-PATENT-CLASS-244-119 ..... N88-23765*
US-PATENT-CLASS-244-120 ..... N88-23765*
US-PATENT-CLASS-244-130 ..... N88-23765*
US-PATENT-CLASS-244-165 ..... N88-23808*
US-PATENT-CLASS-248-548 ..... N88-23982*
US-PATENT-CLASS-248-608 ..... N88-23982*
US-PATENT-CLASS-250-251 ..... N88-24253*
US-PATENT-CLASS-250-423-R N88-24253*
US-PATENT-CLASS-250-427 ..... N88-24253*
US-PATENT-CLASS-264-DIG.64 ..... N88-23894*
US-PATENT-CLASS-264-50 ..... N88-23894*
US-PATENT-CLASS-294-16 ..... N88-23979*
US-PATENT-CLASS-294-106 ..... N88-23979*
US-PATENT-CLASS-294-113 ..... N88-23979*
US-PATENT-CLASS-294-119.2 ..... N88-23979*
US-PATENT-CLASS-297-216 ..... N88-23982*
US-PATENT-CLASS-312-7.2 ..... N88-24163*
US-PATENT-CLASS-312-196 ..... N88-24163*
US-PATENT-CLASS-312-208 ..... N88-24163*
US-PATENT-CLASS-312-300 ..... N88-24163*
US-PATENT-CLASS-315-111.41 ..... N88-24253*
US-PATENT-CLASS-315-111.71 ..... N88-24253*
US-PATENT-CLASS-315-111.81 ..... N88-24253*
US-PATENT-CLASS-315-200-R N88-23942*
US-PATENT-CLASS-315-227-R N88-23942*
US-PATENT-CLASS-315-241-R N88-23942*
US-PATENT-CLASS-315-254 ..... N88-23942*
US-PATENT-CLASS-315-255 ..... N88-23942*
US-PATENT-CLASS-315-276 ..... N88-23942*
US-PATENT-CLASS-315-277 ..... N88-23942*
US-PATENT-CLASS-357-72 ..... N88-23941*
US-PATENT-CLASS-357-74 ..... N88-23941*
US-PATENT-CLASS-357-81 ..... N88-23941*
US-PATENT-CLASS-364-728 ..... N88-24169*
US-PATENT-CLASS-364-757 ..... N88-24169*
US-PATENT-CLASS-367-191 ..... N88-24241*
US-PATENT-CLASS-382-42 ..... N88-24169*
US-PATENT-CLASS-414-735 ..... N88-23828*
US-PATENT-CLASS-414-750 ..... N88-23828*
US-PATENT-CLASS-415-136 ..... N88-23978*
US-PATENT-CLASS-415-170-R N88-23978*
US-PATENT-CLASS-422-246 ..... N88-24544*
US-PATENT-CLASS-425-4-R N88-23894*
US-PATENT-CLASS-525-425 ..... N88-23941*
US-PATENT-CLASS-901-1 ..... N88-23828*
US-PATENT-CLASS-901-33 ..... N88-23828*

US-PATENT-4,573,356 ..... N88-24241*
US-PATENT-4,664,177 ..... N88-23958*
US-PATENT-4,666,561 ..... N88-23846*
US-PATENT-4,708,305 ..... N88-23809*
US-PATENT-4,718,281 ..... N88-23967*
US-PATENT-4,720,139 ..... N88-23982*
US-PATENT-4,723,096 ..... N88-23942*
US-PATENT-4,723,800 ..... N88-23979*
US-PATENT-4,725,106 ..... N88-24163*
US-PATENT-4,726,890 ..... N88-24543*
US-PATENT-4,727,751 ..... N88-23759*
US-PATENT-4,728,257 ..... N88-23978*
US-PATENT-4,731,211 ..... N88-23894*
US-PATENT-4,732,353 ..... N88-23808*
US-PATENT-4,735,381 ..... N88-23765*
US-PATENT-4,736,490 ..... N88-23827*
US-PATENT-4,736,676 ..... N88-23981*
US-PATENT-4,736,815 ..... N88-24241*
US-PATENT-4,738,137 ..... N88-23966*
US-PATENT-4,738,583 ..... N88-23828*
US-PATENT-4,738,831 ..... N88-24544*
US-PATENT-4,740,264 ..... N88-24545*
US-PATENT-4,742,232 ..... N88-24253*
US-PATENT-4,749,839 ..... N88-23980*
US-PATENT-4,750,031 ..... N88-23941*
US-PATENT-4,750,144 ..... N88-24169*
US-PATENT-4,750,543 ..... N88-23958*
US-PATENT-4,752,372 ..... N88-23845*

UTRC-R86-956480-4 ..... N88-23956* #

VPI-E-88-15 ..... N88-23840* #

YALEU/DCS/RR-602 ..... N88-24173 #

☆ U.S. GOVERNMENT PRINTING OFFICE: 1988— 202- 150/ 80015

FEDERAL REGIONAL DEPOSITORY LIBRARIES

ALABAMA

AUBURN UNIV. AT MONTGOMERY LIBRARY
Documents Department
Montgomery, AL 36193
(205) 271-9650

UNIV. OF ALABAMA LIBRARY
Documents Dept.-Box S
University, AL 35486
(205) 348-6046

ARIZONA

DEPT. OF LIBRARY, ARCHIVES AND PUBLIC RECORDS
Third Floor—State Cap.
1700 West Washington
Phoenix, AZ 85007
(602) 255-4121

UNIVERSITY OF ARIZONA LIB.
Government Documents Dept.
Tucson, AZ 85721
(602) 621-6433

ARKANSAS

ARKANSAS STATE LIBRARY
One Capitol Mall
Little Rock, AR 72201
(501) 371-2326

CALIFORNIA

CALIFORNIA STATE LIBRARY
Govt. Publications Section
P.O. Box 2037
Sacramento, CA 95809
(916) 324-4863

COLORADO

UNIV OF COLORADO LIB.
Government Pub. Division
Campus Box 184
Boulder, CO 80309
(303) 492-8834

DENVER PUBLIC LIBRARY
Govt. Pub. Department
1357 Broadway
Denver, CO 80203
(303) 571-2131

CONNECTICUT

CONNECTICUT STATE LIBRARY
Government Documents Unit
231 Capitol Avenue
Hartford, CT 06106
(203) 566-7029

FLORIDA

UNIV. OF FLORIDA LIBRARIES
Library West
Documents Department
Gainesville, FL 32611
(904) 392-0367

GEORGIA

UNIV. OF GEORGIA LIBRARIES
Government Reference Dept.
Athens, GA 30602
(404) 542-8949

HAWAII

UNIV. OF HAWAII LIBRARY
Govt. Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948-8230

IDAHO

UNIV. OF IDAHO LIBRARY
Documents Section
Moscow, ID 83843
(208) 885-6344

ILLINOIS

ILLINOIS STATE LIBRARY
Information Services Branch
Centennial Building
Springfield, IL 62756
(217) 782-5185

INDIANA

INDIANA STATE LIBRARY
Serials Documents Section
140 North Senate Avenue
Indianapolis, IN 46204
(317) 232-3686

IOWA

UNIV. OF IOWA LIBRARIES
Govt. Documents Department
Iowa City, IA 52242
(319) 353-3318

KANSAS

UNIVERSITY OF KANSAS
Doc. Collect—Spencer Lib.
Lawrence, KS 66045-2800
(913) 864-4662

KENTUCKY

UNIV. OF KENTUCKY LIBRARIES
Govt. Pub. Department
Lexington, KY 40506-0039
(606) 257-3139

LOUISIANA

LOUISIANA STATE UNIVERSITY
Middleton Library
Govt. Docs. Dept.
Baton Rouge, LA 70803
(504) 388-2570

LOUISIANA TECHNICAL UNIV. LIBRARY
Documents Department
Ruston, LA 71272-0046
(318) 257-4962

MAINE

UNIVERSITY OF MAINE
Raymond H. Fogler Library
Tri-State Regional Documents Depository
Orono, ME 04469
(207) 581-1680

MARYLAND

UNIVERSITY OF MARYLAND
McKeldin Lib.—Doc. Div.
College Park, MD 20742
(301) 454-3034

MASSACHUSETTS

BOSTON PUBLIC LIBRARY
Government Docs. Dept.
Boston, MA 02117
(617) 536-5400 ext.226

MICHIGAN

DETROIT PUBLIC LIBRARY
Sociology Department
5201 Woodward Avenue
Detroit, MI 48202-4093
(313) 833-1409

MICHIGAN STATE LIBRARY
P.O. Box 30007
Lansing, MI 48909
(517) 373-1593

MINNESOTA

UNIVERSITY OF MINNESOTA
Government Pubs. Division
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 373-7870

MISSISSIPPI

UNIV. OF MISSISSIPPI LIB.
Documents Department
University, MS 38677
(601) 232-5857

MONTANA

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

NEBRASKA

UNIVERSITY OF NEBRASKA - LINCOLN
Love Library
Documents Department
Lincoln, NE 68588-0410
(402) 472-2562

NEVADA

UNIVERSITY OF NEVADA LIB.
Govt. Pub. Department
Reno, NV 89557-0044
(702) 784-6579

NEW JERSEY

NEWARK PUBLIC LIBRARY
5 Washington Street
Newark, NJ 07101-0630
(201) 733-7812

NEW MEXICO

UNIVERSITY OF NEW MEXICO
Zimmerman Library
Government Pub. Dept.
Albuquerque, NM 87131
(505) 277-5441

NEW MEXICO STATE LIBRARY
Reference Department
325 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827-3826

NEW YORK

NEW YORK STATE LIBRARY
Empire State Plaza
Albany, NY 12230
(518) 474-5563

NORTH CAROLINA

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Davis Library
BA/SS Documents Division
Chapel Hill, NC 27515
(919) 962-1151

NORTH DAKOTA

UNIVERSITY OF NORTH DAKOTA
Chester Fritz Library
Documents Department
Grand Forks, ND 58202
(701) 777-4629
In cooperation with North Dakota State Univ. Library

OHIO

STATE LIBRARY OF OHIO
Documents Department
65 South Front Street
Columbus, OH 43266-0334
(614) 462-7051

OKLAHOMA

OKLAHOMA DEPT. OF LIB.
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502, ext. 252

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-6546

OREGON

PORTLAND STATE UNIV. LIB.
Documents Department
P.O. Box 1151
Portland, OR 97207
(503) 229-3673

PENNSYLVANIA

STATE LIBRARY OF PENN.
Government Pub. Section
P.O. Box 1601
Harrisburg, PA 17105
(717) 787-3752

TEXAS

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927—Cap. Sta.
Austin, TX 78711
(512) 475-2996

TEXAS TECH. UNIV. LIBRARY
Govt. Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH

UTAH STATE UNIVERSITY
Merrill Library, U.M.C. 30
Logan, UT 84322
(801) 750-2682

VIRGINIA

UNIVERSITY OF VIRGINIA
Alderman Lib.—Public Doc.
Charlottesville, VA 22903-2498
(804) 924-3133

WASHINGTON

WASHINGTON STATE LIBRARY
Documents Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA

WEST VIRGINIA UNIV. LIB.
Documents Department
Morgantown, WV 26506-6069
(304) 293-3640

WISCONSIN

MILWAUKEE PUBLIC LIBRARY
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3065

ST. HIST LIB. OF WISCONSIN
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-4347

WYOMING

WYOMING STATE LIBRARY
Supreme Ct. & Library Bld.
Cheyenne, WY 82002
(307) 777-5919

National Aeronautics and
Space Administration
Code NTT-4
Washington, D.C.
20546
Official Business
Penalty for Private Use, $300

SPECIAL FOURTH-CLASS RATE
POSTAGE & FEES PAID
NASA
PERMIT No. G 27

NASA

POSTMASTER: If Undeliverable (Section 158
Postal Manual) Do Not Return